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No. 1.

**THE "F.A.Q." CRITICISED, WITH A SUGGESTED
ALTERNATIVE.**

GEO. L. SUTTON, Director of Agriculture.

"In view of the fact that a preliminary shipment of wheat—produced in the last harvest—was being made to London, the Committee appointed a Corn Committee consisting of Messrs. R. McClure, D. Milne, E. J. H. Nicholson and E. J. Hayes, to confer with a Committee of the Fremantle Chamber, consisting of Messrs. E. A. Allnutt, W. H. Evans and F. C. Feely, to adopt an F.A.Q. (fair average quality) sample of Western Australian wheat. Samples of wheat were collected from many districts and, after careful examination and weighing, the standard sample for the harvest 1904-5 was fixed at 62 lbs. weight to the Imperial bushel. This information was sent by cable to London and was communicated to the local Chambers interested and also to the London and Liverpool Corn Trade Associations, to which bodies also sample bags were sent and acknowledged as having been adopted by those associations. In view of the fact that in all probability a surplus of wheat will now be available for export each year, the Chamber proposes to fix an F.A.Q. sample of wheat annually."* So runs the record of the fixing of the first commercial standard for trading in Western Australian wheat.

It will be noted from the opening sentence of this record that it was the export of wheat which brought about the necessity for a trading standard being fixed. Prior to this, and whilst all our wheat was absorbed by the local market, the wheat could be and was sold by sample, i.e., its quality could be judged by a fair sample shown to, and examined by, the buyer at time of purchase. Immediately, however, the personal contact between buyer and seller was broken or became impossible—as in the case of wheat sold for shipment overseas—then a commercial trading standard became necessary in order to smooth out the difficulties incident to trading when long distances separated the seller and the buyer. Such standards are obviously essential in order that buyers, who cannot inspect

* The Fifteenth Annual Report of the Perth Chamber of Commerce for the year ending 30th June, 1905.

the wheat offered for sale, may have indicated to them in a reliable, understandable and definite manner and, at the time the wheat is offered for sale, the quality of the wheat they may expect to receive after purchase. Because of the necessity for the adoption of a trade standard, which arose consequent upon the inauguration of the export wheat trade, following the evolution of our wheat industry with its expanding production, trading by sample in Western Australia gave place to trading under the F.A.Q. standard. The F.A.Q. standard, by which wheat is at present bought and sold throughout Australia, is so-called, because the letters F.A.Q. are the initial letters of the three words in the term "Fair Average Quality," and by custom have become recognised as the commercial abbreviation for that term, and also because it is supposed to represent the fair average quality of the crop of the particular season for which it is fixed.

The F.A.Q. standard was not the only standard which could have been adopted. Obviously, as the export trade was principally with Britain, the standard should be, and was, one of those which were adopted in the contracts recognised by the London Corn Trade Association, *i.e.*, by the body controlling sales of commercial wheat made through London. There are, however, some 60 contracts recognised by that body for the sale of wheat from countries exporting to London. According to Duly* these contracts fall into four groups, as far as the clauses dealing with quality are concerned. In these the quality of the wheat sold is—

- (1) About as per scaled sample;
- (2) About as the F.A.Q. made in the exporting country;
- (3) About as the F.A.Q. made in London and in Plate contracts of a specified weight per bushel;
- (4) According to the official certificate at port of shipment and which is final.

In adopting the standard according to the second group, the Chambers of Commerce in Western Australia fell into line with the practice which was followed in the Eastern States.

It is not known when the system of selling according to this F.A.Q. standard was first introduced, but probably it originated in South Australia about 1870.[†] It was then adopted in Victoria and later in New South Wales.

Although there is an independent standard for each wheat exporting State, the procedure adopted in fixing the F.A.Q. standard is practically the same throughout the Commonwealth. As the standard fixed relates to the crop of a particular season only, it is necessarily fixed annually.

In Western Australia the practice commenced in 1905 has been continued, and the fixing of the standard is undertaken jointly by the Perth and Fremantle Chambers of Commerce, who bear the expense in connection therewith. The actual proceedings take place in alternate years at the headquarters of each Chamber. Last season the standard was fixed in Perth, this season in Fremantle. The President of the Chamber at the headquarters of which the proceedings are carried out is for the time being in charge of the function, and is assisted by leading wheat traders of the State, who comprise the grain committees of both Chambers.

* "Grain," 1928.

† At the conference of wheatgrowers convened by the New South Wales Department of Agriculture, and held in Sydney on July 18-21st, 1910, Mr. J. M. Paxton, for many years Chairman of the Grain Section of the Sydney Chamber of Commerce, stated "South Australia was the first State to adopt the principle (F.A.Q.) and that must have been at least 40 years ago.

Until the season 1928/29 the F.A.Q. standard was fixed from representative samples collected by the Chambers of Commerce from centres at which wheat was delivered throughout the wheat-growing areas. These samples were in the proportion of 1 lb. for every 800 bags (2,400 bushels), which had been delivered up to about the 20th January. Obviously the sample so collected should have been a fair average one of the wheat delivered, but it was contended, and with some justification, that in some instances the samples were picked ones, the object in these cases being a worthy desire to advance the interests of the district. Since then (1928/29) the practice has been to collect the necessary samples from the wheat received at the different ports from which West Australian wheat is exported.

In order to obtain the F.A.Q. standard, wheat samples from each port are mixed together, the weight of the sample used from each port being relative and proportionate to the estimated current season's production of the wheat zone served by that port. After the samples have been thoroughly mixed the natural weight of the Imperial bushel is ascertained with the utmost accuracy. Until the present year it has been the custom to ascertain the bushel weights of the samples received from each port zone, but no good purpose having been served by this practice it is being abandoned and the bushel weight for the State as one unit only is to be determined this year.

As the result of 20 years' intimate association with the actual work of fixing the F.A.Q. standard in Western Australia, it is unreservedly stated that it is impossible to conceive of more careful methods being used for the determination of the bushel weight.

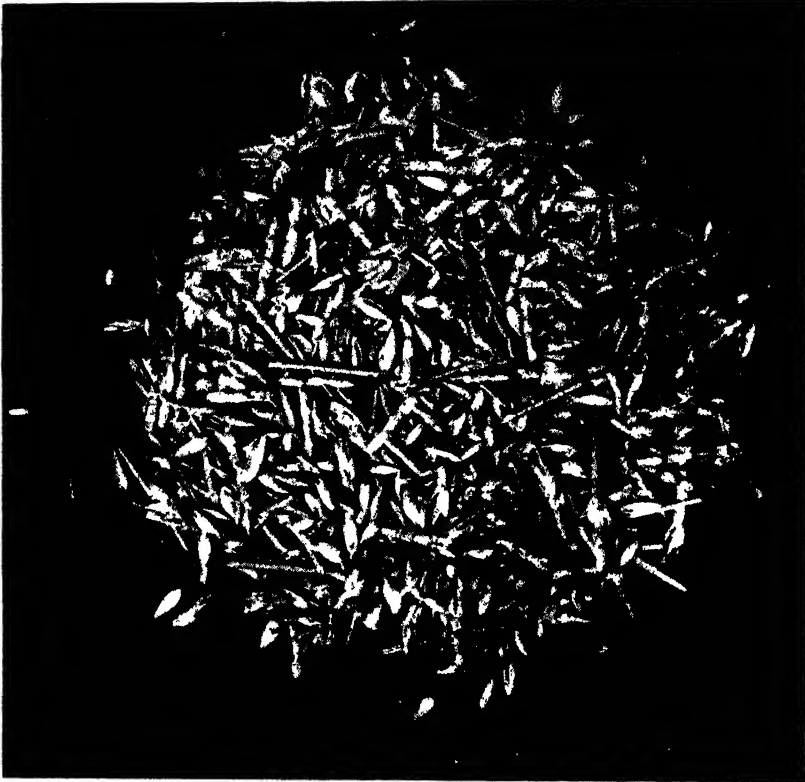
After the actual bushel weight has been ascertained, the Committee, in view of the information available, because of their examination of the samples received and their personal experience of the quality of wheat being delivered by farmers, then consider whether the actual bushel weight shall be subject to any "draft" deduction (ranging from $\frac{1}{4}$ to 1 lb.) before being declared.

The object of this "draft" deduction is to minimise risk of arbitration, which is the right of the British buyer, should he consider that the cargo, as supplied, is not quite up to "standard." The soundness and equity of reducing the bushel weight which has been ascertained with such meticulous care has on more than one occasion been questioned and discussed. The object of its advocates is commendable, in that it is to ensure that the wheat delivered shall be at least equal to, and probably better than, the quality offered at time of sale. This attitude ignores the fact that the contract provides that the wheat sold is "to average at time of shipment about equal to the official standard of the State whence shipment is made," and in consequence the F.A.Q. is a standard or measure by which the quality of a particular cargo can be evaluated. Just as a carpenter ascertains the length of a piece of timber by comparison with his "rule," so the quality and, therefore, the value of a parcel of wheat is ascertained by comparison with the F.A.Q. standard. It will thus be seen that, when a shipper sells a parcel of wheat according to the F.A.Q. standard, it does not mean that he is legally or morally bound to supply wheat of F.A.Q. quality, but that, if the quality delivered is below that standard, then the necessary adjustment shall be made, and this is provided for in the contract of sale.

Seeing that such provision is made in the contract relating to wheat sold according to the F.A.Q. standard, the seller cannot be considered dishonourable, as advocates of the draft adjustment believe, if the wheat delivered is not equal to the quality of the F.A.Q. standard. To be equitable the contract should also provide for an adjusting payment by the buyer when the quality is better than the standard. The effect of such a one-sided arrangement as obtains is that, in

order to avoid arbitration adjustments, the wheat shipper unconsciously desires to have the F.A.Q. standard rather lower than the actual quality of the crop.

The benefits of this draft reduction are one-sided and definitely against the producer of wheat which is above the average as declared, with no benefit even to those whose wheat is on the line or below it. The advantage to wheat shipper and overseas purchaser is that it tends to reduce friction between them by presenting the latter with a bonus of better quality than was arranged and paid for.



Unnecessary Unmillable Material in the F.A.Q. Standard—Foreign Matter, Chaff and Backbone.

In the 1933/34 F.A.Q. standard, after allowing for 1% as a reasonable quantity of total unmillable material, this forms about 0.4% of the total, and in a 50,000,000-bushel harvest (4,000,000 bushels retained on farms), this amounts to about 5,000 tons.

Why pay freight and other charges on what is useless to the miller?

When the decision regarding the standard is made, a declaration as hereunder is signed by the members and officials present. The declaration for this season read:—

"We, the undersigned, present at the Chamber of Commerce, Fremantle, on Wednesday, January 31st, 1934, at the fixing of the weight of the standard bushel of F.A.Q. Western Australian wheat for season 1933/34 hereby certify that it was fairly taken, and the weight fixed, namely 61½ lbs. per Imperial bushel, in our opinion, is the proper weight for the season 1933/34."

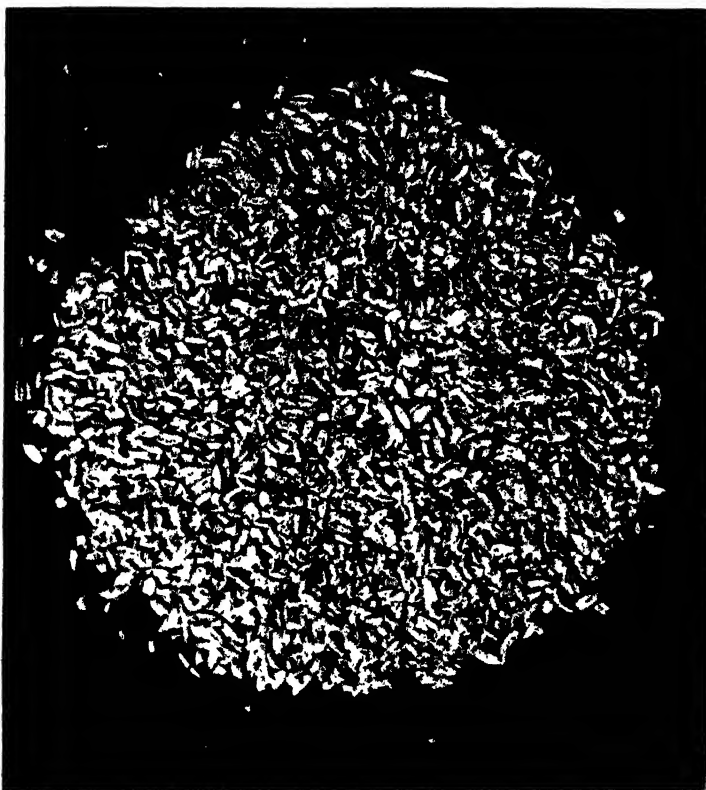
It is now pertinent to consider how this standard suits the requirements of—

1. The overseas purchaser, *i.e.*, ultimately the miller;
2. The Australian wheat merchant and shipper, and
3. The wheat-grower.

The overseas miller requires to know—

1. The kind of flour the wheat will produce, and
2. The quantity of flour obtainable from a given weight of a consignment of wheat.

Provided the wheat is normal the fact that the standard is for Western Australian wheat will indicate to the buyer the kind of flour he can expect to obtain.



Unnecessary Unmillable Material in the F.A.Q. Standard—Fine Unmillable Screenings.

In the 1933/34 F.A.Q. standard, after allowing for 1% as a reasonable quantity of total unmillable material, this forms about 2.6% of the total wheat, and amounts to about 32,000 tons in a 50,000,000-bushel harvest (4,000,000 bushels retained on farms). It is doubtful whether these screenings are paid for, but they can be used to excellent advantage on the farm for stock.

Is it sound economics to pay freight and other charges on unmillable material?

The scrupulous care taken to ascertain the bushel weight of the standard is based upon the assumption that the quality of flour obtainable from a parcel of wheat is indicated by its bushel weight. This is only partly true. The quantity

of flour which may be obtained from a parcel of commercial wheat depends upon the clean millable grain it contains and the character of that grain. The bushel weight will indicate to a limited extent the percentage of unmillable matter in the grain. Under some circumstances, however, it may be entirely misleading. To illustrate this, two samples of commercial wheat were prepared, the bushel weights of which were respectively $62\frac{1}{2}$ and $61\frac{1}{2}$ lbs. If the highest bushel weight always indicates a lower percentage of unmillable material, then the sample weighing $62\frac{1}{2}$ lbs. per bushel should have more millable grain than that weighing $61\frac{1}{2}$ lbs. The reverse, however, was the case, the wheat of the lower weight actually contained nearly 1 per cent. (actually .8 per cent.) more millable grain than the other. The quality of the cleaned or dressed millable grain in each case was identical.

Another instance of a variation from this generally accepted rule is that recorded by Mr. F. L. Shier, B.Sc. (Agr.), in connection with some investigations carried out by the Wheat Branch in 1926.* It was found that a mixture consisting of $99\frac{1}{2}$ per cent. of prime grain and $\frac{1}{2}$ per cent. of unmillable material ("chaff") had a bushel weight of $62\frac{3}{4}$ lbs., and a mixture of 94 per cent. of the same prime grain and 6 per cent. of unmillable material ("screenings") had the same bushel weight; that is to say, the former with over 5 per cent. more millable grain had the same bushel weight as the latter.

To remedy the defect in our F.A.Q. standard it will be necessary to ascertain the bushel weight of the millable grain in the commercial grain and not of the commercial grain itself. This would not be difficult, and its effect would have another very distinct advantage, for the quantity of flour which may be milled from the same variety or type of wheat will increase with the increase in the weight per bushel of cleaned wheat. Thus, the prospective buyer, when supplied with the bushel weight of the cleaned grain, would receive very definite information regarding the quantity of flour he could expect to obtain from it, a very important index of its value. To rely upon the bushel weight of commercial wheat to indicate the amount of millable grain it contains, and the quantity of flour which may be produced from that grain, is like relying upon an indifferent clock for the correct time when a chronometer is available. Just as the man with the poor timekeeper has to make allowances for contingencies if he has trains to catch, so he who buys wheat according to an indifferent standard has also to make allowances for contingencies, and such allowances will be invariably borne by the producer.

Our F.A.Q. lamentably fails when the information regarding its quality is required early in the season. How can we obtain an average of the crop until most of it has been harvested and much of it sold? It is impossible for the F.A.Q. to meet this requirement; the very nature of the standard requires that a large proportion of the season's crops shall have been harvested before the standard can be fixed, and, in consequence, the determination of the standard has to be delayed for at least two months after wheat deliveries have commenced. This delay is unavoidable whilst such a standard is retained. This feature was most unfavourably commented upon by the President of the Liverpool Corn Trade Association in March, 1923, when addressing the Australian editors then touring Great Britain. He pointed out that one of the troubles of the trade in Liverpool (which, of course, applied to other parts of the United Kingdom) was the delay which occurred in connection with the forwarding of standards of the new Australian crop. He further stated that it was then March, and the standards had not been received, although the cargoes sold according to those standards

* W.A. Journal of Agriculture, September, 1926.

had arrived. In consequence of this defect, as evidenced by the complaint just referred to, it is only reasonable to assume that the buyer has to make an allowance for contingencies. Suppose that this, and the allowance consequent upon the unreliable information supplied by the bushel weight of the uncleaned grain amounted to only 1 per cent., the total loss to growers on a crop of 50,000,000 bushels at 3s. 4d. per bushel would amount to between £70,000 and £80,000.

Despite the shortcomings of the F.A.Q. standard and his objection, consequent upon them, to it, the British importer is reluctant to agree to an admittedly better system. This is because he fears that the introduction of any new commercial trading standard will cause him to lose the right, which under the present system he possesses, of submitting to arbitration claims regarding quality after the arrival of the wheat in Great Britain. This aspect of this question was brought up by the Hon. W. F. Dunn, Minister for Agriculture, New South Wales, after his visit to England in 1925 and consequent upon the legislation enacted in connection with the introduction of bulk handling in that State powers were available to fix wheat standards. Speaking on the desirability of a change from the F.A.Q. to permanent standards at the conference of the Ministers of Agriculture held in Adelaide in 1927, he said, *inter alia*:—

"I realise any change of this kind to a permanent can only be brought about very gradually. We passed legislation nearly 12 months ago in regard to bulk wheat standards as a result of my visit to the Old Country, where I ascertained our wheat was sold under the F.A.Q. standard, and a man who grew wheat of doubtful quality, or unclean wheat, received the same price or even better, than he who grew clean and good wheat. I had great difficulty in persuading the powers at the other end to agree we should standardise our wheat. Requests had been made time and again to the members of the Millers' Association whom I met in London, and we found they were hostile; they wanted to retain the present system whereby they arbitrated upon the quality of that wheat which they considered was not satisfactory.

"We had a very great fight with the English and Irish millers whom we met in London, and they said they had broken every attempt by every other country, excepting Canada, to abolish the right to arbitrate in Great Britain. Canada enforced the condition of weight and quality to be fixed at port of shipment. But they broke the back of the Eastern States of America when they tried to enforce the same condition.

"Finally, they did agree that we should set standards, but not too many, say two or three at most. They expected they would receive samples in advance and that the standards would remain constant for many years so that they would then know what they were going to receive. Finally, they were quite agreeable to accept our proposal for permanent standards, but it took a great deal of persuasion.

From the West Australian wheat merchant's standpoint it is difficult to discover any serious defects in the present standard. The inability to fix the standard early in the season is a defect to both the merchant and the producer, but only of minor importance. This is because past experience has taught them, within limits, what to expect and that, except for slight variations in the percentage of the foreign matter, there is little difference between the standard from year to year. An examination of samples of the grain of the F.A.Q. for the seasons 1928/29-1933/34 will disclose little essential difference between them. From the West Australian shippers' standpoint the F.A.Q. standard may be regarded as satisfactory as any commercial standard can be. Except for the amount of unmillable material it contains, it may be regarded almost as a permanent standard.

The producer of wheat containing less, or no more, than the average amount of unmillable matter has little to complain about in connection with the present standard. The grower of average wheat receives its value, and though the grower of the lower grade may be subject to a dockage, some dockage can only be regarded as equitable. The grower of superior wheat containing less than the average amount of foreign matter is, however, at a serious disadvantage, and, indeed, is unfairly treated, in that he does not receive the cash premium for superior commercial value. Thus, the incentive to the improvement of the merchantable quality of the main crop is removed, and the careful farmer who desires to produce as properly cleaned a sample as is practical is discouraged rather than encouraged. In fact, unless the price for F.A.Q. standard is less than parity the premium which should be paid for the better wheat is distributed amongst the growers of average and inferior wheat, and they are therefore being paid more than they are entitled to at the expense of the more careful farmers. This is not only unfair, but it removes the incentive to improvement. This lack of incentive tends to reduce the efficiency of our best farmers in the harvest field to a dead level of mediocrity, or worse.

Because of the lack of incentive, farmers do not utilise to the best advantage the engineering skill used in the construction of Australian harvesting machinery. Because of the excellence of this machinery it is believed, after allowing for difficulties inseparable from field work, that the grain can be so "dressed" or cleaned that no more than 1 per cent. of screenings or other unmillable material need be left in it. The F.A.Q. standard allows for nearly four times this amount—in 1927/28 it was 5.5 times—and in consequence many farmers now cover up or remove the tailing screens from their harvesters, whilst the more scrupulous ones allow them to become choked, thus deliberately lowering the commercial value of our main agricultural product by including a much larger percentage of unmillable material—foreign matter and screenings—than is necessary. Though some of this may be of use to the miller for making bran and pollard, it is very doubtful if the farmer gets paid for it.

Not only is the present standard unfair to the good and careful farmers, but it also entails a loss to every wheat farmer, consequent upon the cost of the handling and transport of unnecessary material. Some idea of the enormous and unnecessary aggregate waste to the State consequent upon the unnecessary non-millable material in the F.A.Q. standard may be estimated from calculations hereunder, which indicate the amount of wasteful tonnage and cost of handling same in a West Australian crop of, say, 50,000,000 bushels, and an Australian crop of 200,000,000 bushels:—

ESTIMATED LOSS DUE TO THE TRANSPORTING (EXCLUDING HANDLING CHARGES) OF 3% UNNECESSARY UNMILLABLE MATERIAL IN THE F.A.Q. STANDARD.

Western Australia.

Harvest—50,000,000 bushels:

Exports (as wheat and flour)	..	..	..	..	43½ million bushels
Home consumption (flour)	..	..	..	..	2½ million bushels
Retained on farm	..	..	..	..	4 million bushels

Export—43,500,000 bushels:

3% of this = 1,305,000 bushels = approx. 35,000 tons

	£	£
Sacks—435,000 at 9s. per dozen	..	16,313
Cartage—35,000 tons at 5s. per ton	..	8,750
Railway Freight—35,000 tons at 12s. per ton	..	21,000
Sea Carriage	..	52,500

Home Consumption—2,500,000 bushels:

3% of this = 75,000 bushels = approx. 2,010 tons

	£
Sacks—25,000 at 9s. per dozen	938
Cartage—2,010 tons at 5s. per ton	502
Railway Freight—2,010 tons at 6s. per ton	603
	<hr/>
	2,043
Total	<hr/>
	£100,606
Total—	£
Export	98,563
Home Consumption	2,043
	<hr/>
	£100,606

It will thus be seen that the loss incurred amounts to over £100,000; add to this the sum of £75,000, the estimated loss due to contingencies, and we have a total of £175,000 borne collectively by the wheatgrowers of Western Australia, most, if not all of which, it is believed, can be saved if the growers make up their mind to demand a change in our standard.

Australia.

Harvest—200 million bushels:

Export	150 million bushels
Home consumption (flour)	30 million bushels
Seed, feed, etc.	20 million bushels

Export—150 million bushels:

3% of this = 4,500,000 bushels = 120,540 tons

	£	f
Sacks—1,500,000 at 9s. per dozen	56,250	
Cartage—120,540 tons at 5s. per ton	30,135	
Railway Freight—120,540 tons at 12s. per ton	72,324	
Sea Carriage—120,540 tons at 30s. per ton	180,810	
	<hr/>	
		339,519

Home Consumption—30 million bushels:

3% of this = 900,000 bushels = 24,108 tons

	£	£
Sacks—10 million at 9s. per dozen	11,250	
Cartage—24,108 tons at 5s. per ton	6,027	
Railway Freight—24,108 tons at 12s. per ton	14,465	
Sea Carriage—24,108 tons at 30s. per ton	36,162	
	<hr/>	
		67,904
Total		<hr/>
		£407,423

Total—	£
Export	339,519
Home consumption	67,904
	<hr/>
	£407,423

If to this be added the estimated loss of 1 per cent. for contingencies amounting to some £300,000 we have the enormous sum of over £700,000.

Briefly, the defects of the present F.A.Q. Standard are—

1. It cannot be fixed early enough to suit overseas buyers.
2. The natural bushel weight of the commercial wheat is not always a true index of its merchantable quality.
3. It is unfair to the careful farmers who should be encouraged.
4. Its incidence is the cause of great economic waste.

The first two defects could be remedied by the adoption of a fixed standard stating the natural bushel weight of the millable grain. The other two defects would be partially remedied also by the adoption of a fixed standard, if the latter provided that the percentage of millage grain should be in excess of that now found in the F.A.Q. The whole of the defects would be remedied by the adoption of—

1. Selling by grade as in Canada and the United States of America.
2. Selling on a "Clean Wheat" basis and according to the actual bushel weight of the millable grain in the parcel.

Already, as the result of the advent of bulk handling in New South Wales, murmurings are heard about the advisability of introducing the system of selling our wheat according to grades. It certainly has the advantage that such a system very accurately assesses the value of the different types of wheat contained in a country's crop, but such a system is necessarily complicated and unnecessarily complicated for Western Australia, where the types of wheat grown are all very similar and have in common with each other such flour characteristics as colour, brightness and dryness, the greatest difference in any characteristic would be in strength. The extent of this difference need not prevent the very strong varieties being mixed with the softer ones, provided due recognition was made of their relative monetary value, or, if desired, the very strong varieties could be kept separate as premium wheats, as is the practice at present in some instances.

The present plan of having one class common to all varieties rather than several grades is simpler and suits West Australian conditions. The plan of selling on a "Clean Wheat" basis is, therefore, preferred to that of selling according to grades. Its underlying principle is that a parcel of wheat would be sold according to the "clean" wheat it contains. This would be in line with the sale of milk according to test, and the sale of wool according to its yield of clean scoured wool. On the "Clean Wheat" basis all producers would be treated fairly, but those who produced the cleanest wheat would receive the greatest monetary return and this would, in consequence, encourage the greatest efficiency in harvesting and cleaning the grain; this, in its turn, would have the effect of minimising the enormous economic loss due to handling and transporting unnecessary unmillable material.

Dealing on a "clean wheat" basis would not remove the right, so dear to believers in British justice, to arbitrate in cases where the buyers have doubt as to whether the quality of the grain they are receiving is equal to that offered for sale prior to purchase. It would, however, remove two of the principal defects associated with the right to arbitrate under the present F.A.Q. system, viz.:-

- (a) The unreasonable delay which may take place in connection with the arbitration; and
- (b) The risks attending arbitration based upon *personal* opinion of the individual.

In order to safeguard the buyer for the inconvenience and risk of having to purchase wheat during the greater part of the season according to a yet unknown standard, the right to arbitrate has had to be extended to an unusual extent, and, in consequence, the claims for arbitration can remain in abeyance until 21 days later than the receipt of the F.A.Q. standard sample. It can thus happen that final payment regarding the sale of a wheat cargo may remain in abeyance for three or more months after the sale has been made. Such a condition cannot be regarded as satisfactory, and it would be difficult to find any other commodity of importance subject to such trading conditions.

Dissatisfaction will always exist whilst disputes as to quality rest solely upon the personal opinion of any individual, however skilled and experienced he may be. This is especially the case when the shipper has no definite information, as at present, regarding the basis on which the arbitrator forms his opinion. Though it is admitted that, as the result of many years of experience, some men become remarkably skilful in assessing the relative values of two parcels of commercial wheat, yet such a method is no longer in accordance with the progress which has been made in connection with our knowledge of wheat and its value for milling. During comparatively recent years a great deal of investigational work has been carried out in connection with the milling properties of wheat, and information is now available so as to provide a "technique" whereby the samples of the parcels in dispute can be dissected into their component parts, and their milling value, *i.e.*, their commercial worth evaluated, on a much sounder basis, and, to the disputants, on a more satisfactory one, than an expression of opinion as the result of "matching." It is now possible to assist the skilled judgment by simple and accurate tests, in much the same manner as the bushel weight of a small sample of wheat is determined, not by empirical means, but a specially devised instrument called a chondrometer.

In 1921, the writer first called attention to the defects of selling wheat according to the F.A.Q. standard, and in 1926, consequent upon announcement that the Minister for Agriculture in New South Wales intended to introduce permanent standards for dealing with the New South Wales wheat crop, a paper was read before the Australian Association for the Advancement of Science at the Perth meeting on 27th August, 1926,* suggesting the terms to be used in connection with such standards and defining the character of same. In 1929, having realised by then the objections to two or more selling standards for Australian wheat, the use of a permanent standard limiting the amount of foreign matter to 3 per cent. was advocated as an improvement upon the existing method. To deal on a "clean wheat" basis is on similar lines but goes somewhat further in the direction of eliminating unnecessary foreign matter and unmillable material from our commercial grain, but it conforms to custom and retains the term "F.A.Q." for the clean grain and in consequence the commercial advantages attaching to trading in accordance with an F.A.Q. standard.

Dealing on a "Clean Wheat" basis would, in effect, be dealing according to a permanent standard, which would be available as early as required in any season. Selling on a "Clean Wheat" basis would make it easy to adopt the provision of selling also on the basis of the bushel weight of the cleaned wheat in each parcel. This would be in line with the excellent practice of selling wool according to its quality, as well as according to its yield on a "clean" basis. There is nothing revolutionary in this proposal. It is not new as far as some countries are concerned; export wheat from Canada and the United States is sold on a "Clean Wheat" basis, as also, it is believed, is wheat from India, and as already pointed out, the London contracts for the sale of wheat from South America provide that the bushel weight of the parcel shall be specified. Nor would it be a serious departure from our present practice. At present the local buyer estimates how closely the parcel of wheat submitted by the farmer approaches the quality of the F.A.Q. standard. Unconsciously he estimates the percentage of the unmillable grain and the bushel weight of the uncleaned grain. So, if our wheat were purchased on a "Clean Wheat" basis, the local buyer would soon learn to estimate, with considerable accuracy, the percentage of millable material in the sample and its bushel weight. In case of disputes the amount of

* "The F.A.Q. and other Commercial Standards for Trading in Australian Wheat" Journal of the Department of Agriculture of W.A., September, 1926.

unmillable material would be accurately determined by suitable sieves, or a special machine, and the bushel weight by the chondrometer. In the United States of America the unmillable material is determined by a small machine resembling a winnower, known as a "kicker." In Australia it is probably a slightly different type of machine, which included a Carter disc separator and a circular screen, would be more suitable.

The suggested alternative to the F.A.Q. would certainly be an advantage to both buyer and seller, for it would state the amount of millable grain purchased, and it would indicate in a reliable and definite way, the quantity of flour which could be produced from a given weight of that wheat. Apart from the slight derangement inseparable from the introduction of any new plan, the alteration would present no special difficulties and, once introduced, would work just as smoothly as the present method, but with greater fairness to the producer and, it is believed, with more satisfaction to the buyer.

SHEEP AND WOOL NOTES.

Hugh McCallum, Sheep and Wool Inspector.

With the wool season practically over, it might be well to review the past four years, and see how we have fared regarding the production of wool. There has been a great demand for wool by every manufacturing country, and the outlook for the future is particularly bright and important from the point of view of sheep husbandry. Therefore the greatest care in the production of wool must be exercised by all concerned in the breeding of our sheep so that only the best possible is produced, which will meet with ready sale to oversea buyers.

During the period when sheep and wool were low in value, many flock owners neglected their sheep by the purchase of "scrub" rams, breeding their own rams, permitting the rams to run with the flocks from shearing to shearing, inbreeding, neglecting to cull, failing to dip to keep the flocks free from infestation, and by lack of feeding. An unfortunate attitude, no doubt, but sheep were unsaleable and wool of little value. During the period under review, however, some farmers took the opportunity to cull heavily, selling the undesirables at any price and replacing them with high grade ewes. These farmers have reaped their just reward.

Every district in this vast State has some particular advantage or disadvantage besides climate, and these peculiarities all help in the production of the different types of wool displayed on the floors of the wool warehouses. The best will always be obtained by a good breeder simply because he is watchful for improved results, and knows when to stop or continue, as the case may be. We are producing at present a large quantity of good wool, a credit to the growers, but we are also growing a large quantity of wool that is uneven in fibre and this principally is due in many cases to a lack of general knowledge. There are outstanding cases of many being too anxious to get to the top by "short cuts."

Many farmers purchase several rams from different studs and in most instances they have not had satisfactory results because they have not kept to one blood. Some sheep men have used long stapled rams that shown an open back, on dense-stapled ewes with bad results. In many flocks the result of such breeding can be seen, and if the wool is carefully opened, many of the staples are

found to be uneven in length of the fibre, caused by the attempt to combine the characteristics of sire and dam. Such breeding leads to irregularity in the fleece and lowers the value of the wool by having too many qualities of wool in the one fleece. Breeding on the lines stated above has a further great objection in that cross fibres may be produced.

AVOID EXTREMES.

It is of the utmost importance to be careful when mating rams, that extremes are not blended, either as regards length of staple or quality of wool. Improvement can only be effected by a gradual process and it is just as much to be observed in breeding flock sheep as it is in the breeding of the studs. In fact, it is most important with the flocks large or small, for from here is where the bulk of the wool comes; it is from this that the buyers judge for value. If the sheep breeder finds he is losing length, or the wool is becoming too open, he should discover the cause. It is a mistake to think it can be rectified by simply obtaining a ram with characteristics that may suit the purpose, from another breeder. Stick to the blood you have and then try and get a ram with moderately greater length and density as the case may be, and gradually work back to what is required. Changing the blood often only aggravates the offence, so to speak, besides opening the way to other faults.

BREEDING FROM IMMATURE SHEEP.

Many so-called farmers still continue to run the rams with the ewes throughout the year; why, it is hard to understand. They often admit the mistake. Breeding from stock that is too young is often done, and this is one of the many causes of deterioration, both in constitution and frame. Another mistake is to expect the rams to serve too many ewes. Rams should not be used until they are twenty months old. A good old ram is better than a bad young one. Young ewes are generally bad mothers compared with older sheep. One of the drawbacks in breeding from ewes that are immature is that they are only maturing themselves, and will often neglect their offspring, besides which their organs are not sufficiently developed to enable them to lamb easily. Losses often occur, both of the mother and the young.

MATING.

Farmers often find that when the rams are joined to the ewes, they will not work. With British breeds it is often that they are too fat, or that both the ewes and rams are carrying too much condition. Rams and ewes should be in fair condition. Over-feeding is often detrimental to a successful lambing. If the farmer thinks the ewes have not all been served, he may keep the rams in a little longer. Some of the ewes may "come on" and take service, although the lambs would be a little later than the others. Still the ewes are breeding, and a lamb is of value to-day. Before joining the rams to the ewes both should be inspected and the ewes examined to see that they have no dags or dirt hanging to their wool.

In the early part of the summer the eyes of the sheep should be examined for blindness, and their feet, if they have grown too much, should be cut back. Very often the sheep man neglects attending to the feet. This work would save a great deal of lameness.

BREEDING EWES AND THEIR CARE.

Breeding ewes should receive the best of feed and should be kept in good condition throughout the year. It is to these ewes that the farmer looks for the improvement in his flock. Neglected ewes cannot breed good lambs. If the ewes have done well, the lambs will drop strong and healthy, and the ewes will be able to rear them on a plentiful milk supply. Ewes in lamb should never be driven far or fast. Crushing through gates and the flock being dogged should at all times be avoided, as abortion may take place.

Before lambing, and especially in districts where the blow-fly is troublesome, it is very necessary to "crutch" the ewes. When lambing occurs this will prevent damp, dirty wool attracting the blow-fly.

LAMBING.

The lambing season is a busy time of the year, and certainly the most critical. The percentage of lambs raised will depend largely upon the care and patience of the farmer. Arrange the work if possible so that considerable time can be spent amongst the flock during the time of lambing. The object of every farmer should be to increase the percentage of lambs. Losses during and after lambing are very high.

WEANING THE LAMBS.

Lambs are usually weaned when about five months old. However, the correct time will depend largely upon conditions. If the season is bad it will pay to leave them rather longer with their mothers. Ram lambs must be weaned earlier, or they may give trouble with the ewe lambs. When the lambs are taken from the ewes, it is wise to put in a few dry ewes with them. The old sheep will steady them and lead them to water. Young lambs are timid and easily frightened, may not feed and hang in corners. The young sheep must never receive a set-back.

THE BLOW-FLY MENACE.

The mortality amongst sheep from attacks of the blow-fly is becoming more serious every year than the sheep farmers are aware; individually they are doing their best to eradicate this pest, but unless some general action is taken it will prove sooner or later to be the greatest danger to the pastoral industry. Flies deposit their eggs on the wool of the sheep, and as the excrement accumulates and putrifies around the tail, they will be first deposited there, or on any wound. The maggots are scarcely hatched before they burrow under the skin and torment the sheep by the severity of their bites. It may be useful to the beginner with sheep to know the symptoms of the sheep affected:—Sheep hanging down their head, stamping their feet, shaking their tails, running and biting themselves, and, in the case of rams struck on the belly, trying to scratch themselves with their hoof. The injured parts should be carefully treated and they will soon heal. Leaflets on treatment and prevention are available from the department.

FAT LAMB RAISING FOR EXPORT.

Excellent results have been obtained overseas for lambs bred in the State, and providing preparation is made by other lamb breeders for more attention to detail, the export trade will increase; only the best will do. While relying on the ram for the larger number of suitable points from the buyers' point of view, it must be always remembered that the ewe makes the fat lamb. She must be not only prolific, but essentially a heavy milker, for the lamb must never receive

a check after birth. The ewes should always have a balanced ration from the different fodders that can be grown on the farm, varying in character according to the season.

When handling the lambs prior to forwarding them to market, no unnecessary roughness should be used, so as to avoid the rejection percentage, as bruised lambs mean lower prices.

It is regrettable that a few years ago many farmers rushed into this business without due preparation, and naturally they did not enjoy success. They started on the wrong lines. Uneven nondescript ewes cannot produce the uniform type of lamb the trade demands; ewes must be of sound constitution and good conformation. It is regrettable that many unscrupulous dealers (not breeders) disposed of large numbers of rams of doubtful pedigree to farmers who had no previous experience in lamb breeding. It is best to purchase requirements only from registered stud breeders who have a reputation to maintain. It must not be forgotten that the oversea market is still a predominate factor in the disposal of the best lambs, that good feeding and climatic conditions will grow them to maturity during a comparatively short period. Quick transport to market is necessary, as no class of live stock loses weight like lambs. The breeder in this branch of sheep husbandry must be ever watchful from the time they are dropped until they are marketed.

MIXED FARMING.

Recent experience in the wheat farming industry is inducing more men on the land to go in for sheep and wheat, as a surer means of securing payable returns. In this State there has been too many wheat-growers and not enough mixed farmers. No wheat-grower can utilise the whole of the area to the best advantage without sheep. Sheep are a very necessary part of a farmer's plant in helping to keep the paddocks clean, and by combining the two, should there be a failure in the wheat crop, the sheep are a good stand-by. Wool prices are good and sheep, if purchased rightly, are one of the best investments for the man on the land. But they must not be allowed to lose their commercial value through lack of correct feeding during the late summer and autumn. To provide the reserves of feed at the lowest possible cost, they should be grown on the farm.

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If you are not receiving the *Journal*, which is issued quarterly, and wish to do so, please forward your name and postal address to the Director of Agriculture, Perth.

HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION TESTING SCHEMF, 1933-34.

Conducted by Dairy Branch, Department of Agriculture, Perth.

Progress Report of Results to 31st January, 1934.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Butter Fat.	Owner.	Sire.
MATURE COWS (OVER 5 YEARS OLD)—STANDARD 350 LBS. BUTTER FAT.											
Koolan Bonnie Elizabeth	Guernsey...	1899	23-3-27	5-5-33	273	24½	6.253	570.97	...	A. W. Padbury	Robin of Nundorah
Gravelle Lady Fowler 3rd	Jersey	19111	30-5-25	6-5-33	273	22	9.036	404.84	...	R. H. Rose	Rye Duke of Glen Iris
Kardale Pride	Guernsey...	1981	1-10-27	26-3-33	273	27	9.306	477.79	...	G. E. Scott	Mennamurra Oliver Twist
Numbawarra Lulu	A.I.S.	4022	21-9-26	11-5-33	273	31	10.640	429.03	...	D. Bevan & Sons	Fairy's Fock of Fairfield
Springmead Barbara	Jersey	13265	20-2-22	9-2-33	273	31.5	6.228	417.47	...	Sabina Vale Stud Farm	Springmead Ogram
Woorooloo May 2nd	A.I.S.	15145	25-10-26	22-10-32	273	19.5	8.518	403.07	...	Woorooloo Sanatorium	Commercial of Blackheath
Nooka Pearl	Jersey	28189	2-12-27	6-12-32	273	20	6.930	400.64	...	S. P. Herbert	Jeside's King of Samla
Picture 8th of Raleigh	A.I.S.	17524	22-4-27	19-3-33	273	35	10.710	390.82	...	D. Bevan & Sons	Union Jack of Raleigh
Carnation of Minachorpe	do.	17524	6-5-26	3-11-32	273	8	8.724	387.25	...	R. Bee & Sons	Bruce of Sunnyvale
Moortlands Agnes	Jersey	23680	11-6-26	6-5-33	273	12½	6.867	366.95	...	P. Rose	Colonel of Melrose
Claremont Ruddy 8th	A.I.S.	17008	10-8-27	18-1-33	273	18	9.069	363.49	...	Hospital for Insane	Telyarup Prince of Claremont
Murek Butkerup	Guernsey...	17533	19-10-27	22-5-32	273	21	7.008	363.99	...	Murek College	Triumph of Wollambar
Roselynn 2nd of Raleigh	A.I.S.	20285	2-9-25	23-4-33	273	25	9.345	360.99	...	D. Bevan & Sons	Union Jack of Raleigh
Moortlands Benil	Jersey	17481	24-1-27	23-4-33	273	12½	6.832	314.87	...	P. Rose	Colonel of Melrose
Black 4th of Raleigh	do.	17489	9-2-26	27-10-32	240	14.5	8.043	305.74	...	D. Bevan & Sons	Colonel of Melrose
Black 13th of Raleigh	do.	17489	18-3-27	27-10-32	210	21	6.570	282.45	...	D. Bevan & Sons	Barriester of Raleigh
Carnation 2nd of Minachorpe	do.	14119	25-1-22	23-11-32	210	21	6.570	281.76	...	R. Bee & Sons	Collier of Darbala
Melba 46th of Darbala	do.	17472	19-11-26	20-12-32	240	22	7.170	272.62	...	H. O. Timms	Kitchener of Darbala
Diamond 3rd of Raleigh	do.	18396	6-8-22	23-11-32	273	23	6.910	269.91	...	D. Bevan & Sons	Union Jack of Raleigh
Springmead Hinnosa	Jersey	23918	6-8-27	30-4-33	240	12	5.920	262.71	...	C. H. Ironmonger	Springmead Ogram
Fairy Eye of Grass Vale	do.	24918	8-8-27	30-4-33	240	11	5.920	262.71	...	P. Rose	Rye Duke of Glen Iris
Moortlands Blur	do.	1616	22-3-26	11-2-33	210	20	5.700	237.79	...	A. W. Padbury	Grater of Melrose
Koolan Lady Betty 4th	Guernsey...	1048	24-4-24	11-2-33	210	20	5.700	237.79	...	A. W. Padbury	Robin of Nundorah
Sparfield Air Girl 2nd	do.	1048	24-4-24	23-10-32	273	12	4.981	256.92	...	Murek College	Milton Blackheath
The Flower of Telvarup	A.I.S.	14747	24-4-22	23-10-32	210	10.5	6.075	241.00	...	H. O. Timms	Carl of Blackheath
Springmead Lady Ogram	Jersey	18295	2-11-23	11-1-33	273	18	5.709	240.10	...	Sabina Vale Stud Farm	Springmead Ogram
Tabbagoon Dove 5th	A.I.S.	4467	3-11-27	6-4-33	180	27	5.565	238.35	...	W. G. Burges	Dalry's Gift of Hillyview
Murek Carnation	Guernsey	1800	30-5-27	29-10-32	240	15.5	5.040	235.53	...	Murek College	Triumph of Wollongbar
Blackheath Milkmaid	A.I.S.	10091	9-7-18	6-10-32	240	9	6.210	233.79	...	H. O. Timms	Flower's Mayfield of Blackheath
Vandy 8th of Oakdale	do.	12931	0-12-19	8-1-33	273	16.5	6.259	228.39	...	H. O. Timms	Standard of Oakdale
Thelma of Blackheath	do.	14748	24-9-20	13-11-32	210	12.5	6.000	214.95	...	H. O. Timms	Flower's Mayfield of Blackheath
Della 11th of Oakdale	do.	9355	0-7-18	1-11-32	210	12	4.875	187.86	...	H. O. Timms	Courage of Oakdale
May of Woorooloo	do.	15144	18-6-25	15-5-33	90	28	3.195	141.93	...	Woorooloo Sanatorium	Commercial of Blackheath
Murek Lily	Guernsey...	1801	16-2-27	4-5-33	120	18	2.370	125.97	...	Murek College	Triumph of Wollambar
Brookvale Noble Lily	Jersey	24894	19-6-26	23-6-33	90	27.5	2.475	106.74	...	G. F. Combs	Noble Lad of Roelands
Daisy of Glauson	A.I.S.	Found- ation	1926	13-2-33	90	33	3.075	106.44	...	D. Bevan & Son	...

COWS OVER 4 YEARS AND 6 MONTHS AND UNDER 5 YEARS OLD—STANDARD 330 LBS. BUTTER FAT.

Nooka Carnation	Jersey	25218	17-5-28	14-12-32	273	26	8,293	5-8	Jesse's King of Sarnia
Springport Starbright's	do.	24901	16-3-28	10-10-32	273	25	7,590	6-0	Prince Mariona of Grass Vale
Denmark Rose Pearl 3rd	Guernsey	1798	23-11-27	20-10-32	273	19	6,942	5-4	Rose Chief of Wollongbar
Denmark Prince	do.	2527	3-3-29	19-4-33	273	15	5,956	5-4	Triumph of Wollongbar
Venus 8th of Balogh	A.I.S.	17540	3-2-28	16-10-32	240	15	8,370	3-9	Royal Standard of Darbarala
Moortlands Cella	do.	29210	15-5-28	30-3-33	273	13	6,429	5-0	Colonel of Melrose
Moortlands Ceres	do.	29211	17-5-28	26-3-33	273	9	5,593	5-4	Colonel of Melrose
Springmead Fern	Jersey	...	5-3-28	5-12-32	273	10	5,025	4-8	Springmead Islander

COWS OVER 4 YEARS AND UNDER 4 YEARS AND 6 MONTHS—STANDARD 310 LBS. BUTTER FAT.

Tetyrup Duchess	A.I.S.	2504	9-12-28	4-3-33	273	42	13,792	3-8	Baron of Darbarala
Tipperary Pansy	A.I.S.	2442	2-12-28	25-3-33	240	26	7,395	4-5	Villiers of Darbarala
Kurrawong Nancy 3rd	do.	...	9-3-29	29-4-33	273	15	7,320	4-2	Premier 2nd of Kurrawong
Moortlands Corona	Jersey	28223	16-11-28	3-5-33	240	8	4,620	5-6	Melrose Romeo
Tabbagong Society 7th	A.I.S.	1695	7-1-29	7-2-33	240	10	6,180	3-7	Daley's Gift of Hillview
Lottie 5th of Kurrawong	do.	18225	8-11-28	11-2-33	120	24	3,150	...	Premier 2nd of Kurrawong

COWS OVER 3 YEARS AND 6 MONTHS AND UNDER 4 YEARS OLD—STANDARD 290 LBS. BUTTER FAT.

New Park Amy 7th	A.I.S.	1863	14-6-29	31-1-33	273	34	10,902	3-7	Ruler of Greyleigh
New P R Sally 9th	do.	1873	30-4-29	4-4-33	273	23	10,839	3-9	Ruler of Greyleigh
Moortlands Duchess	Jersey	31239	11-7-29	9-5-33	273	13	7,134	5-2	Moortlands Romeo
Minnamurra Palm Olive	Guernsey	2616	30-8-29	27-4-33	273	17	6,906	4-7	Caramana Favour
Tipperary Melba 3rd	A.I.S.	2358	11-10-29	12-4-33	273	21	7,863	4-0	Melba's Re Echo of Tipperary
Minnamurra Currency Lass	Guernsey	2606	7-10-29	2-4-33	273	14	6,162	5-0	Caramana Favour
Nooka Wild Rose	Jersey	28191	31-12-28	28-12-32	240	17	5,955	4-7	Monroe East of Glen Iris
Banyule Silverline 5th	do.	29033	10-2-29	29-12-32	273	21	5,973	4-6	Banyule Superstrain
Denmark Red Rose 3rd	Guernsey	2521	6-3-29	13-1-33	273	14	4,467	5-8	Rose Chief of Wollongbar
Clarendon Eyre Tangerine	Jersey	33352	24-4-29	29-11-32	273	20	5,491	4-1	Clarendon Eyre Embuena Music M.
Glaucoun Venus	A.I.S.	2389	6-4-29	25-10-32	240	19	5,370	4-1	Pinecreek Dunbar
Banyule Silverline 6th	Jersey	29847	10-9-29	3-6-33	90	34	3,090	...	Milkmaid's Chief of Panyale

COWS OVER 3 YEARS OLD AND UNDER 3 YEARS 6 MONTHS—STANDARD 270 LBS. BUTTER FAT.

Cooklabal Jewel	Guernsey	3771	13-3-23	13-2-33	273	24	7,497	4-8	Cooklabal Pride 2nd
Burnside Judy	Guernsey	2540	3-5-23	2-10-32	273	14	5,933	5-8	Minnamurra Prairie Don
Springhurst Melilot 4th	Jersey	31615	2-4-30	23-4-33	273	17	6,451	5-3	Valiant Prince of Glen Iris
Springhurst Belle donna 4th	Jersey	31614	12-2-30	13-4-33	273	19	6,124	5-1	Starbright's Prince of Glen Iris
Berrington Soprano 2nd	Guernsey	25351	7-10-29	19-1-33	273	19	5,263	5-9	Banyule Superstrain
Wollongbar Rosebud	Guernsey	2749	1-1-30	14-2-33	273	16	6,243	4-9	Wollongbar Satisfaction
Tipperary Priestella	A.I.S.	2535	9-9-29	1-3-33	273	23	7,044	4-09	Villiers of Darbarala
Clarendon Billy 13th	A.I.S.	2532	11-12-29	7-1-33	173	22	6,951	4-1	Clarendon Eyre
Grassvale Cream Goods	Jersey	31414	24-4-31	11-10-32	273	13	6,340	4-5	Choice Goods of Garden Hill
Tipperary Royal Lady	A.I.S.	2377	11-11-25	22-10-32	273	9	6,072	4-3	Melba's Re Echo of Tipperary
Spurfield Dead donna	Guernsey	2764	23-1-30	2-2-33	273	18	5,004	5-1	Spurfield Eastern King
Wynna Lady Dawn	Guernsey	2472	17-11-29	9-1-33	273	15	4,740	5-3	Nundorah Prosper
Denmark Rose 4th	Guernsey	2794	9-8-29	27-12-32	273	16	5,013	4-8	Denmark Stud Farm
Melba 5th of Minil	A.I.S.	5294	12-3-29	15-2-33	210	25	6,210	...	Barugh Dairyman
Wollongbar Haughty	Guernsey	2,492	30-11-29	18-2-33	240	11	3,585	...	Wollongbar Hopeful

HERD TESTING—continued.

COWS OVER 2 YEARS 6 MONTHS OLD AND UNDER 3 YEARS OLD—STANDARD 2500 LBS. BUTTER FAT.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk last day of Test.	Weight of Milk for period.	Average Test.	Butter Fat.	Owner.	Sire.
Clarendon Whitty Maid 11th...	A.I.S.	...	2-6-30	1-5-33	273	30	10,596	3.9	384.38	Hospital for Insane	Clarendon Elector
Nooka Lass	Jersey	28,187	14-1-29	25-12-32	273	234	10,596	4.8	384.38	S. P. Herbert	Jessie's King of Fania
Clarendon Poppy 3rd	A.I.S.	...	16-3-30	11-3-33	273	224	10,596	4.0	367.05	Hospital for Insane	Clarendon Elector
Clarendon Peggy Primrose	Jersey	33,038	31-10-29	23-10-32	273	22	6,178	5.0	354.53	Sabbath Vale Stud Farm	Banyule Alto
Mokine Miss Fox	Jersey	...	24-11-29	10-10-32	273	18	5,560	5.8	354.53	M. H. Wilding	The Valley Twylsh Fox
Justine Juliet 6th	Jersey	34,344	20-10-29	10-10-32	273	15	4,950	5.8	372.60	Jess L. Hancock	Nokine Replne
Clarendon Rose Pearl 5th	Guernsey	3,281	20-8-30	2-8-33	273	13	4,245	5.8	372.60	Denmark Stud Farm	Return of Wollongbar
Mokine Empire Twylsh	Jersey	...	30-12-29	13-10-32	273	18	4,669	5.1	356.62	M. H. Wilding	The Valley Twylsh Fox
Mokine Columbine 6th	Jersey	...	15-2-30	10-10-32	273	18	4,734	4.7	356.62	T. H. Wilding	The Valley Twylsh Fox
Mokine Veronica Bye	Jersey	31,164	10-11-29	17-1-32	240	9	3,780	6.7	105.67	T. H. Wilding	Rye Duke of Glen Iris
Springmead Island Flower	Jersey	...	5-5-30	10-1-33	273	64	3,154	4.6	143.68	Sabbath Vale Stud Farm	Springmead Islander
COWS UNDER 24 YEARS OLD—STANDARD 2300 LBS. BUTTER FAT.											
Koolan Bo-Peep	Guernsey	3,542	26-2-31	18-4-33	273	23	6,759	5.77	390.15	A. W. Padbury	Honestead Ace
Widow Waa Roy 5th	A.I.S.	5,117	20-4-30	18-10-32	273	34	9,252	3.8	359.21	W. G. Burgess	Parkview Mayflower Kinrath
Clarendon Cigarette 4th	A.I.S.	...	21-11-30	13-4-33	273	29	8,472	4.0	340.39	Hospital for Insane	Searchlight of Sunnyvale
Clarendon Beauty 4th	A.I.S.	...	21-11-30	21-10-32	273	16	7,084	4.4	303.36	Hospital for Insane	Searchlight of Sunnyvale
Clarendon Lady Mint	Jersey	...	21-11-30	14-12-32	273	24	5,517	5.5	303.66	Robinson Bros.	Fern's Masterfire of G.H.
Glenavon Pecklops	A.I.S.	2,366	21-8-30	12-12-32	273	20	7,287	4.1	301.58	D. Bevan & Sons	Villiers of Darbalara
Parkview Poppy 3rd	Guernsey	3,513	13-2-31	22-2-33	273	61	4,810	6.2	289.64	A. W. Padbury	Honestead Ace
Denmark Irish Lass	A.I.S.	4,135	20-8-30	20-1-33	273	21	7,538	4.0	283.94	W. G. Burgess	Mayflower's Repeater of Hillkew
Denmark Cream Duchess 5th	Guernsey	3,269	30-8-30	12-12-32	273	18	5,544	5.1	280.52	Denmark Stud Farm	Denmark Empire (Chief)
Mokine Amy	Jersey	...	4-4-31	4-10-32	273	17	5,676	4.9	270.11	R. H. Rose	Campaniles Duke of Burekup
Woolaroo Jean	Jersey	5,221	15-7-30	9-11-32	273	19	5,622	4.8	270.62	T. H. Wilding	Mokine Replne
Nooka Daisy	Jersey	...	27-2-31	7-11-32	273	141	4,993	5.3	266.35	Farm	Triumph of Pine Creek
Moondia Florie	Jersey	...	10-6-31	28-3-33	273	13	3,612	5.1	258.47	S. P. Herbert	Springpark Prince Ragtime
Parkview Model	A.I.S.	...	20-10-30	28-1-33	273	25	6,134	3.9	258.47	P. Rose	Melrose Sultan
Springmead Lady Rose	Guernsey	3,322	8-10-30	4-11-32	273	23	5,911	3.9	255.79	W. G. Burgess	Joan's Monarch of Blacklands
Moondia Flower	Jersey	...	16-7-30	14-12-32	273	24	3,802	4.7	255.62	S. D. P. Hayes	Denmark Radiant Chief
Moondia Nellie Bye	Jersey	...	13-6-31	8-5-33	273	27	4,403	5.7	254.12	Sabbath Vale Stud Farm	Springmead Beaucaire
Moondia Fiona	Jersey	34,754	16-9-31	8-10-32	273	91	3,498	4.6	253.69	P. Rose	Melrose Clarion
Nooka May Queen	Jersey	...	8-5-31	18-5-32	273	101	3,804	5.2	253.69	C. H. Ironmonger	Colwyn Captain Mac.
Widow Waa Beauty 7th	Jersey	...	19-4-30	14-11-32	273	13	3,541	3.0	250.42	P. Rose	Melrose Sultan
Longridge Gentle	A.I.S.	5,116	6-4-31	10-5-32	273	16	5,829	4.2	244.70	S. P. Herbert	Springpark Prince Ragtime
Parkview Favorite 2nd	A.I.S.	4,127	19-7-31	27-10-32	273	11	4,453	4.1	244.70	W. G. Burgess	Parkview Mayflower's Monarch
Denmark Rose Dams 2nd	Guernsey	3,280	19-7-31	30-10-32	273	15	4,453	4.1	244.70	R. H. Rose	Markville Kitchen
Moondia Lady Rye	Jersey	34,753	13-8-30	10-10-32	273	144	3,808	4.9	244.70	D. G. Burgess	Wollongbar Reformer
Murek Poppy	Guernsey	3,293	1-8-30	8-11-32	273	17	4,808	4.5	244.70	M. H. Wilding	Wollongbar Reformer
Burnside Princess	Guernsey	3,324	1-8-30	25-10-32	273	17	4,808	4.5	244.70	M. H. Wilding	Wollongbar Reformer
Tavagan Ice Cream	Jersey	...	30-8-30	27-12-32	273	134	3,820	5.5	216.87	T. H. Rose	Triumph of Wollongbar
Mokine Sapphire	Jersey	...	30-8-30	29-10-32	273	17	4,461	4.7	210.07	T. H. Rose	Denmark Radiant Chief
Clarendon Lupa 7th	A.I.S.	5,107	16-1-31	28-12-32	240	18	4,515	4.07	183.24	D. Bevan & Sons	Mokine Ruby
Claryn Showgirl	Jersey	34,756	28-11-30	16-12-32	273	14	4,047	4.3	174.35	C. H. Ironmonger	Clarendon Forrester

A BLOWER ELEVATOR ATTACHMENT TO THE CHAFFCUTTER.

GEO. L. SUTTON,

Director of Agriculture.

For many years it has been quite usual to find a wide belt or slat elevator attached to chaffcutters for the purpose of elevating chaffed hay into a storage bin or room. More rarely has such an elevator been used for elevating chaffed greenstuff into a silo. The reason for this is that, for smooth working, these belt and slat or bucket elevators require to be driven from the top; it is not difficult to provide this drive when the distance between the driver pulley on the chaff-cutter spindle and the driven pulley at the head of the elevator is comparatively short, but, with the greater distance between the chaffcutter and the top of the tub or tower silo, the difficulties are so much increased that the belt type has never been very popular with silage makers. Since the advent of the blower type of elevator they have been almost entirely superseded by this type for elevating greenstuff.

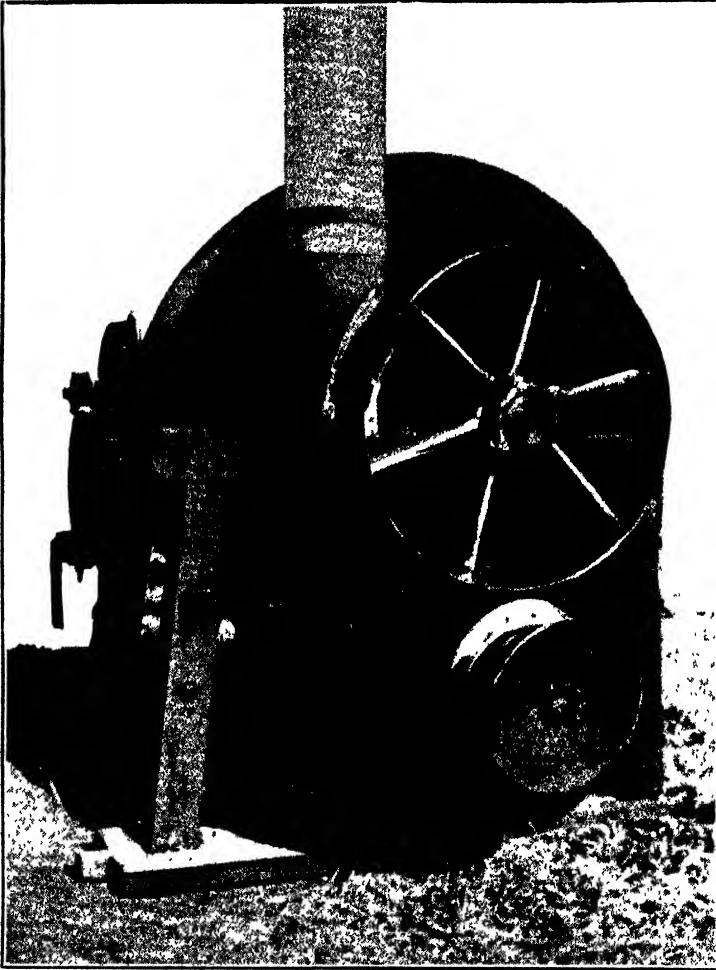
Such blowers have almost invariably been attached to American machines designed for cutting up thick-stemmed crops like maize, the principal silage crop of the United States of America, and for this purpose they are very suitable. These machines are, however, not well adapted for chaffing greenstuff of the thin-stemmed cereal type and not at all adapted for chaffing cereal and meadow hay, which is in continuous use the year round on West Australian farms.

The chaffcutter, on the other hand, is not only particularly suitable for chaffing hay, but it is also equally suitable for cutting up the cereal greenstuff from which silage in Western Australia is mainly made. Experience has also shown that the chaffcutter is quite suitable for cutting up green maize or sorghum for feeding direct to stock, or for the silo. The chaffcutter can therefore be used for both chaffing hay and greenstuff, and for West Australian conditions is more suitable and useful than the special silage cutter which can be used with advantage only for cutting up greenstuff.

To meet the requirements of the modern silage maker, the chaffcutter requires to have a blower elevator attachment. In the special silage cutters of the chaffcutter type the blower fan is fixed to the main spindle to which is also attached the cutting wheel. Such an arrangement is not possible with the West Australian chaffcutter, for the blower to lift the greenstuff the desired height—30 to 40 feet—has to be driven at such a high speed that the wheel of the chaffcutter, if run at that speed, would be driven at too great a speed for efficiency and safety; the chaffcutter wheel might even be driven into pieces. To obviate this in the special silage cutters the cutting wheels are specially strengthened, but this renders them much less suitable, if not entirely unsuitable, for chaffing hay. The difficulty of attaching a blower-elevator to the chaffcutter has, however, been overcome by attaching the blower fans to a spindle other than that to which the knife wheel is fixed. For dealing with chaffed hay Mr. H. Smith, a farmer in the Manmanning district, has had an attachment for the purpose on the market for some years.

As far as is known the first attachment to be used successfully for silage making was designed and made by Mr. R. D. Sims, "Waihopui," Highbury. An illustration of this appeared in "The Westralian Farmers' Gazette" of the 10th February, 1927, and which is reproduced in Fig. 1. This attachment has been

working successfully now for seven years, and not only is it used once yearly for filling the twin silos, 28 feet high, but it is used throughout the year for filling a chaff room with chaffed hay. For this latter purpose the chaff is elevated vertically 14 feet, and then blown horizontally 12 feet along the shed and through a home-made dust extractor. The blower is attached to a "Zealandia" chaffcutter with an 11-inch mouth and normally elevates 6 to 7 tons of chaffed



COMBINED CHAFF AND SILAGE CUTTER.

A "Zealandia" Chaffcutter with blower elevator attachment, made by Mr. R. W. Sims, "Waihopai," Highbury.

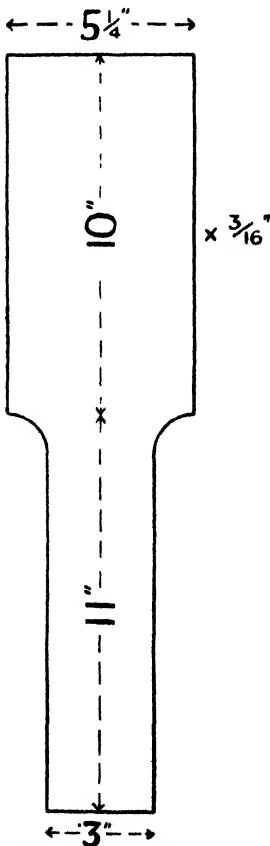
green material per hour, but its full capacity is greater, as 2 tons have been cut and elevated in 13 minutes. The blower was farm-made from harvester parts; the out-of-pocket expenses for these and for the 30 feet of 6-inch galvanised elevator piping and head-piece were £4 1s. 3d.

Stimulated by the need at the Amondale Stock Farm for a machine which could be used throughout the whole year for chaffing hay to meet the farm

requirements, and once a year for filling the 100-ton silo, and also encouraged by the achievement of Mr. Sims, it was decided to purchase a "State" chaff-cutter and attach a blower to it. This has been successfully done with the assistance of Messrs. H. J. Clucas, G. M. Dear and A. B. Mather, of the staff of the Perth Technical College, who designed and built the blower and casing, and attached same to the chaffcutter. The blower was designed for a speed of approximately 650 revolutions per minute.

The blower consists of six steel arms of T-cross section mounted in a cast-iron boss, and attached to a spindle $1\frac{1}{2}$ inches in diameter; the over-all diameter of the arms is 3 feet. Secured to the end of the arms are the fan blades of sheet steel $\frac{3}{16}$ inch thick. The blades proper are machined to the following dimensions—width $5\frac{1}{4}$ inches, length 10 inches. Extending from the bottom of the blade is the shank by which the blade is riveted to the arm, this shank is 3 inches wide and 11 inches long.

The wheel as constructed was made from material that was available. Had it not been desirable to utilise this material, there is no doubt that the design could have been improved upon.



Sketch of Fan Blade.

The width of casing enclosing the fan is 6 inches wide with $\frac{1}{2}$ inch clearance beyond the ends of the fans. In order to use some 8-inch galvanised piping for the elevator tube the outlet from the casing has been increased to accommodate this. The cut material from the chaff-cutter is fed into the blower casing by means of an apron, which directs the cut material from the bottom of the wheel to where it enters the fan casing at an opening just above the spindle. The air inlet is provided by another opening on the opposite side of the casing.

The heaviest duty required of the blower is to lift green cut cereals to the top of a silo 33 feet high; to perform this work, with the chaff-cutter being fed at full capacity and at about 300 revolutions per minute, the speed of this 4-foot blower requires to be not less than 630 revolutions per minute. With a fan of smaller diameter its speed and number of revolutions per minute would require to be greater, as is the case with the blower of Mr. Sims, with 800 to 850 revolutions per minute.

Trials at Avondale have shown the importance of driving the blower fast enough. With a speed of 520 revolutions per minute the blower choked almost immediately the greenstuff entered the casing. With a speed of 600 revolutions per minute the blower elevated the material, provided the chaffcutter was fed lightly, say, slightly more than half its capacity. With a speed of 630 revolutions per minute the material was elevated readily, even when the chaffcutter was fed to its full capacity of 6 to 7 tons of greenstuff per hour.

One of the drawbacks associated with this combination, which requires that the blower be driven separately, and not driven on the same spindle as the cutting wheel, is that the distance between the centres of the two spindles is necessarily very short. This involves the use of a short belt, and this is mechanically unsound as the gripping surface on the pulleys is relatively small; this defect is minimised by having the pulleys on the blower wheel spindles reasonably large. As the optimum speed of the blower is in the vicinity of 630 revolutions per minute, and that of the chaffcutter 300 to 350 revolutions per minute, the relative sizes of the pulleys required were as 1 : 2, the diameters of those used were 10 inches on the blower and 20 inches on the chaffcutter.



COMBINED CHAFF AND SILAGE CUTTER.

A "State" Chaffcutter with blower elevator attachment.

The trials at Avondale also demonstrated that, for smooth running, it is essential to drive the blower direct from the engine, with the chaffcutter driven by means of appropriate pulleys from the blower shaft. It was found that, when the chaffcutter was driven direct from the engine, and the blower from a pulley on the chaffcutter, the blower would slow down and choke when the feeding was a little heavier than usual.

The power used to drive the combination is an 8-horsepower Crossley oil engine. For cutting and elevating the green cereals with which the silo is filled it is barely powerful enough, and, in consequence, the cutter requires to be fed very carefully and regularly.

When the chaffcutter is used for chaffing green cereals, which have been cut with a reaper and binder, it is advisable, in order to lessen the possibility of the cutter choking, to feed the material into the rollers butts first rather than heads first, as is the practice when chaffing cereal hay.

The combination chaffcutter and blower has proved extremely satisfactory. Except for the care necessary in feeding the cutter the 33-foot silo has been filled without difficulty, and the green material has been chaffed more evenly than previously when the special type of silage cutter was used. Since the silo has been filled the combination has been used for filling a loft with chaffed cereal hay. When on this work the chaffed hay has to be blown vertically about 18 feet and horizontally the length of the shed, about 35 feet. It is doing this quite satisfactorily and apparently the engine is powerful enough for this work.

FRUIT FLY.

SEASON 1933/34.

GEO. W. WICKENS, Superintendent of Horticulture.

It is many years since the Fruit Fly pest has done as much damage as it has during the present season, and in searching for the cause of the increase in the number of flies I am convinced the principal factor has been a much greater carry-over through the winter—in the orange crop—than is usual, owing to mild weather conditions.

I am indebted to the Commonwealth Meteorologist, Mr. Curlew, for particulars regarding temperatures in Perth, Kalamunda, Guildford, and Donnybrook, which show that in June, September, and November of 1933 the average for those months was considerably above normal, and in commenting thereon he states:—"Perth and fruit and dairying districts experienced warmer nights than usual for June. Except for one or two sharp spells the nights were remarkably warm and the average minimum temperature for the month was three to five degrees higher than the general average."

Anyone who is familiar with the manner in which fruit flies congregate in the orange orchards towards the end of autumn and early winter will readily understand what warm weather in June means in assisting the flies to use the fruit as a host. Under these conditions many fruits would, and did, successfully carry the eggs of the pest, and many of the over-wintering flies found the early spring weather conditions highly suitable for breeding purposes. On one day in that month—25th—Perth recorded 87deg., Guildford 89deg., Kalamunda 84deg., and Donnybrook 84deg. With oranges and loquats to provide facilities for egg laying at that period the resultant flies arriving on the scene in November found ideal conditions in a heavy crop of early peaches and apricots, and weather conditions again above normal.

The average maximum and minimum temperatures for November, and those obtaining in November, 1933, as supplied by Mr. Curlew, show:—

Perth:

Average maximum for November	75.7deg.
Average minimum for November	56.8deg.
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Average maximum, November, 1933	80.3deg.
Average minimum, November, 1933	59.0deg.

Guilford:

Average maximum for November	79.8deg.
Average minimum for November	55.1deg.
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Average maximum, November, 1933	85.3deg.
Average minimum, November, 1933	57.3deg.

Kalamunda:

Average maximum for November	76.9deg.
Average minimum for November	54.9deg.
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Average maximum, November, 1933	85.3deg.
Average minimum, November, 1933	57.3deg.

Donnybrook:

Average maximum for November	75.8deg.
Average minimum for November	50.1deg.
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Average maximum, November, 1933	79.5deg.
Average minimum, November, 1933	50.8deg.

I think in the above I have shown good reason why fruit flies are more numerous this season than usual, but there is no guarantee that similar weather conditions will not occur next season, and the only way to guard against serious losses is for all orange growers in infested areas to be vigilant in winter time as well as in summer.

Unfortunately, very few take the steps necessary to control fruit fly in the winter months: traps are seldom used, and fruit lies on the ground for a week or more at a time before it is picked up. As a result the pest carries through the winter to find a congenial breeding ground in early summer stone fruits and later—February, March, April—severely attacks Valencia oranges, finishing the season under ideal conditions for again carrying through the winter.

Readers are referred to the article by the Entomologist (Mr. Newman) appearing in this issue for formulae for use in the control of fruit fly by foliage baiting and trapping, and all fruit growers are earnestly urged to concentrate on exterminating the winter brood, for this cannot be achieved in summer when the pest has become a plague.

DENMARK WASTING DISEASE.

J. F. FILMER, B.V.Sc., Senior Veterinary Surgeon,
and

E. J. UNDERWOOD, Ph.D., B.Sc., Animal Nutrition Officer.

“Wasting Disease” is the name which has been coined for a disease which affects cattle and sheep in some parts of the Denmark district. It is characterised by progressive emaciation and anaemia followed by death, and by the fact that affected animals recover when transferred to sound locations. This disease was first brought under the notice of the Department of Agriculture in November, 1921, when only a few farmers were experiencing trouble. With the advent of Group Settlement and its attendant land development the problem assumed more serious proportions, until by 1928, some forty farms, comprising a total area of about five thousand acres, were known to be affected.

The unsound farms all contain a proportion of karri hill country and the disease appears to be associated with this type of land. It must, however, be emphasised that on many farms situated on karri slopes no trouble is experienced in rearing healthy calves.

The disease generally affects calves between the ages of six and eighteen months, though younger calves are sometimes affected and, during recent years especially, the disease has occurred amongst mature cattle. These latter have seldom been affected when they were receiving concentrates, the protective effect of bran being particularly noticeable in this regard. Unfortunately, concentrates do not appear to have any effect in preventing the disease in calves. Sheep, and especially lambs, are even more susceptible than calves, and two instances have been reported of their suffering from the disease where no trouble is experienced with calves.

The disease most commonly occurs during the spring and early summer, when there is an abundance of green feed, but it is not entirely confined to this time of the year.

After the first symptom to be noted is depraved appetite, the calf manifesting a marked inclination to chew bark, sticks, bracken, bones, earth, etc., followed usually by a gradual decline in general appetite. The calves show little interest in pasture and then neglect it altogether, until finally they cannot be tempted to eat even such delicacies as crushed oats or bran. There is a falling off in condition, which may be quite rapid when loss of appetite has supervened. Diarrhoea is generally noted, particularly in young calves, and blood and slime is often seen in the dung.

The hair becomes long, the skin scurfy, and there is often redness and tenderness on the inside of the hind legs. The calves become weak, are easily exhausted, and finally are unable to stand. Death generally occurs in from six weeks to six months, though in mature cattle the disease may run a longer course.

When the disease was first reported in 1921, the Department was unable to spare officers to make thorough investigations. However, the problem was kept in mind and, from 1921 to 1928, veterinary officers made several visits to the district. The resemblance to "bush sickness" in New Zealand was early noted, but unfortunately the remedies which had been successfully used against that disease did not prove correspondingly effective in Denmark. In 1928 a series of experiments were conducted by the Department on an affected farm, and from 1928 to 1931 a number of settlers conducted experiments under the supervision of departmental officers. In addition, a large number of chemical analyses of pastures, soils, stock waters and blood were made during this period. Considerable attention was also devoted to a study of the pathology of the disease, including numerous post mortem and blood examinations. The result of this work was to confirm the opinion, which had long been held, that the disease was a form of malnutrition, due in all probability to some deficiency in the composition of the pasture.

However, as the chemical analyses had given no clue and the food supplements tried had proved ineffective, the Department decided to lease an affected farm from 1st June, 1931, and an extensive series of experiments was initiated on this holding under the direct control of the Department.

Lambs had been proved to be susceptible to the disease and their use would enable a much greater number of experiments to be conducted than would have been possible with calves, so they were chosen for the first year's experimental work. This policy has been abundantly justified, as it has been possible to confirm with calves all results which were achieved with lambs.

In the initial series of experiments 80 lambs were used and 12 different forms of treatment were tried. In all, 92 sheep and 48 calves have been used on the leased farm and the preventive and curative measures tried have been increased to 35. Amongst the supplements tried were compounds of iron, copper, manganese, iodine, phosphorus, lime, magnesium and arsenic; substances from sound holdings such as chaff, creek water, soil and jarrah ash; and such biological products as dried blood, meat meal, dried pig stomach, and various preparations of liver.

The first substance with which "Wasting Disease" in sheep was cured was a proprietary liver preparation known as "Heparadine," which was kindly donated by Heparadine Pty. Coy., Ltd. This was first used successfully in May and June, 1932. Later it was arranged for liver to be dried at the Government abattoirs and



Calf 36—Affected with Wasting Disease; weight, 30/9/33, 286 lb.



Calf 36—After treatment with Limonite; weight, 19/12/33; 456 lbs.

this was successfully used in the treatment of affected sheep and cattle. Raw liver in quarter-pound doses given twice daily also cured affected heifers. But all efforts to obtain an effective liver preparation which was convenient and cheap met with failure.

Iron and ammonium citrate, which was the first remedy successfully used in the treatment of New Zealand "bush sickness," consistently failed to cure "wasting disease" when given in the doses recommended in New Zealand, though it sometimes appeared to cause temporary improvement. These doses prevented the development



Calf 17—Affected with Wasting Disease; weight, 28/6/33, 354 lbs.



Calf 17—After treatment with Limonite; weight, 16/11/33; 560 lbs.

of the disease in seven out of nine lambs and in three out of four calves on the experimental farm. The lambs, however, did not grow nearly as well as they should have done.

In September, 1932, the effect of a treble dose of this drug was tried and met with excellent results. This prompted a search for an iron compound which was cheap, palatable and harmless in large doses. It was finally decided to try an iron ore known as "limonite" which had replaced all other agents in the treatment of "bush sickness" in New Zealand. This was first used in November, 1932, when it was given in very large doses to a badly affected heifer. Recovery was rapid, and by February, 1934, the animal was completely cured. Limonite has now been responsible, on the experimental farm alone, for the recovery of 13 sheep and five calves. Since January, 1934, it has been administered to 21 cattle, 12 of which are under two years old. All have maintained excellent condition. In addition, it has been used by a number of settlers, all of whom have so far given favourable reports.

Limonite has been compounded into a lick and is being sold by Messrs. Cuming, Smith, Mount Lyell, Ltd., under the name of Denmark Lick No. 1. It has the following formula—

Limonite	..	..	..	..	..	100 parts
Copper sulphate	..	..	..	..	..	¼ part
Dicalcie Lick	..	..	..	..	..	40 parts
Linseed Meal	..	..	..	..	..	20 parts

The prices are £11 10s. per ton and 13s. 6d. per cwt., cash on rails Perth.

It is suggested that this lick be fed in the following doses:—No lick should be given to calves under one week; calves from one week to six months, ½ ounce twice daily; from six to 12 months, 1 ounce twice daily; over 12 months, 1½ ounces twice daily. All affected animals should be given the full dose of 1½ ounces twice daily irrespective of age. It is hoped that when animals have become thoroughly healthy, it may be possible to reduce the above doses considerably, but owners would be well advised to adhere to the recommended doses for at least six months after first using. The best method of giving this lick is mixed with the feed, and for cows it is most conveniently given at milking time. It is strongly recommended that special small bails be provided for calves and that special small bails be provided for calves and that they be fed in these twice daily.

For the sake of those who have not had much experience in rearing calves the following procedure, which has given excellent results on the experimental farm, is appended. Calf to run with the cow for 24 hours after birth, or it may be removed immediately. In any case it should receive the milk from its mother for at least four days. During the first week, give two quarts of whole milk twice daily and increase this to three quarts twice daily for the next three weeks. In the fifth week, give twice daily two quarts whole milk and one quart skim milk with ¼ pound pollard mixed in. This will accustom the calf to eating dry feed in the bail. In the sixth week, change to one quart of whole milk and two quarts of skim milk twice daily. The milk should now be followed by ¼ pound of crushed oats at each meal. From seven weeks to six months the calf should receive three quarts of skim milk followed by ½ pound crushed oats twice daily. After weaning, it is wise to continue the oats until the calf is 12 months old, when it may be gradually replaced by chaffed meadow hay. The lick should be given first in the milk, then in the oats and finally with the chaff. Do not put the lick out in the paddock for stock to take at will as this method is wasteful and does not ensure each animal obtaining its proper share. It is absolutely necessary to ensure that the full dose is eaten by each animal.

The Department will welcome reports concerning the results following the use of Denmark Lick No. 1, whether these be favourable or adverse.

FIELD EXPERIMENTS WITH WHEAT AND OATS, EXPERIMENT FARMS, 1933.

L. Thomas, Superintendent of Wheat Farms.

Although over the greater part of the wheat belt the total rainfall for the conventional growing period (May to October) was about equal to the average, the incidence of the precipitations was not altogether satisfactory.

Following upon the dry summer and autumn the seasonal winter rains did not commence until the beginning of the last week in May. This gave no opportunity for weed destruction prior to seeding some of the crops, and consequently many of those sown on a dry seed bed suffered considerably from weed competition.

Crops planted after the commencement of the rains suffered less in this direction and in most cases the results were more satisfactory.

The rainfall for May, June, July and August was above the average and in some districts trouble was experienced through waterlogging. During September and October a dry and rather anxious period was experienced. However, the crops withstood this better than might have been expected.

The experience of this season indicated that when weeds are likely to be troublesome it is desirable to wait for the rains before seeding. This may entail the planting of suitable early and very early maturing varieties and farmers would do well to retain a reserve supply of seed of a variety such as "Noongaar" wheat in anticipation of a late opening to the season.

The results of the experiments conducted at the Dampawah, Yilgarn, Merredin and Chapman experiment farms are given below. The results of the experiments at the Salmon Gums Experiment Farm and the Wongan Hills Light Lands Farm will appear in the June issue of this Journal.

With but one or two minor exceptions the experimental plots are all one-eighth of an acre in area (833 links by 15 links), replicated five times and each treatment compared with an adjacent control.

The superphosphate used throughout the experiments had a phosphoric acid content of 22 per cent.

DAMPAWAH EXPERIMENT FARM.

Farm Manager, F. A. Newman.

The monthly rainfalls as recorded at the farm during 1933, together with the average for the past six years, are set out hereunder:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
					May.	June	July.	Aug.	Sept.	Oct.				Total.
1933 ... ..	...	11	120	25	385	508	130	257	46	68	1,304	77	28	1,665
Average 5 years ...	13	49	67	44	215	270	157	162	55	61	920	83	56	1,232

The soil is a red friable loam originally carrying york gum, giant mallee, mulga and karara scrub. A three year rotation of fallow, wheat, and pasture is followed and all plots, except where otherwise stated, are planted on fallow.

The land on which the experiments were carried out was (unless the nature of the experiment required other treatment) ploughed during June and July, 1932, and was cultivated with a springtyne implement during September. All plots were planted with a combined cultivator drill.

The results of field experiments conducted during 1933 are tabulated below.

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 5th May, 1933.

Variety—Gluyas Early.
Seed—45 lbs. per acre.

Superphosphate—80 lbs. per acre.

Treatment.	Computed Yields per Acre.			Average Yields per acre. 1933.	Percentage Yields. 1933.	Average Yields per acre. 1930-33.	Percentage Yields. 1930-33.
	Section 1.	Section 2.	Section 3.				
Fallow	bus. lbs. 22 24	bus. lbs. 22 24	bus. lbs. 21 52	bus. lbs. 22 13	% 108	bus. lbs. 16 45	% 116
Non-Fallow	19 20	21 20	22 0	20 53	100	14 26	100

These results show that the yields of the wheat crop are increased when the land is fallowed.

TIME OF PLOUGHING EXPERIMENT.

Planted on 5th May, 1933.

Variety—Gluyas Early.
Seed—45 lbs. per acre.

Superphosphate—80 lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre. 1933.	Percentage Yields. 1933.	Average Yields per acre. 1930-33.	Percentage Yields. 1930-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
June	bus. lb. 22 10	bus. lb. 24 24	bus. lb. 23 54	bus. lb. 24 8	bus. lb. 24 56	bus. lb. 23 55	% 100	bus. lb. 16 58	% 100
August	19 28	23 30	20 48	23 72	22 0	21 57	92	15 54	94

The results for this year and the average results obtained over the four years that the experiment has been conducted indicate that the yields are increased when the land is ploughed during the early winter months. These are in conformity with similar experiments conducted at the other experiment farms.

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 8th May, 1933.

Variety—Gluyas Early.
Seed—45 lbs. per acre.

Superphosphate—80 lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre. 1933.	Percentage Yields. 1933.	Average Yields per acre. 1930-33.	Percentage Yields. 1930-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
2 inches	bus. lb. 24 40	bus. lb. 21 36	bus. lb. 23 44	bus. lb. 20 40	bus. lb. 22 48	bus. lb. 22 42	% 93	bus. lb. 15 20	% 94
4 inches	22 48	24 8	25 12	24 40	24 40	24 18	100	16 23	100
6 inches	23 4	22 40	24 32	20 40	25 28	23 17	96	16 7	98

The results for this year and also the average results obtained over the period of four years that the experiment has been conducted, indicate that it is most economical to plough to a depth of 4 inches.

MULCHING EXPERIMENT.

Planted on 8th May, 1933.

Variety—Gluyas Early.
Seed—45 lbs. per acre.

Superphosphate—90 lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Cultivated before Seeding only ...	24 0	22 8	22 48	22 16	21 44	22 35	103	19 1	101
Cultivated in spring and before seeding ...	22 24	19 44	23 4	22 0	22 24	21 55	100	18 50	100
Cultivated in spring, during summer after rain, and before seeding ...	21 52	23 44	21 44	22 0	20 8	21 54	100	18 19	97

* No results for 1931.

† This plot received four additional cultivations during the late spring and summer months.

These results do not indicate that any advantage is derived from cultivating fallow during the spring or summer months at this farm. Lack of response to the spring cultivations may possibly be due to the friable nature of the soil and the absence of weed growth.

TIME OF SEEDING EXPERIMENT.

Variety—Gluyas Early.

Superphosphate—90 lbs. per acre.

Seed—45 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1932-33.	Percentage Yields, 1932-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
18th April ...	20 48	19 44	20 16	18 56	21 4	20 9	95	16 57	95
16th May ...	20 56	21 12	23 28	20 32	20 8	21 15	100	17 50	100
17th June ...	13 28	13 12	13 52	13 52	13 28	13 34	64	10 34	59

As the winter rains did not commence until late in May, those plots sown in April germinated at the same time as those sown in May.

TIME OF SEEDING EXPERIMENT.

Variety—Noongaar.

Superphosphate—60 lbs. per acre.

Seed—45 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1931-32.	Percentage Yields, 1932-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
16th June ...	16 40	19 12	19 4	19 36	20 8	18 56	100	17 37	92
18th May ...	18 24	18 0	18 16	16 56	18 0	17 56	100	19 3	100
15th July ...	8 16	8 48	9 36	10 16	8 32	9 6	51	5 30	29

Both this year's results and the average results obtained over the two years that the experiment has been conducted, indicate that it is unwise to plant an early maturing variety after the end of May. The average results also indicate that, even when a very early maturing variety is planted, it is not a safe procedure to extend the planting period too far into June.

RATE OF SEEDING EXPERIMENT.

Planted on 28th April, 1933.

Variety—Bencubbin.

Superphosphate—90 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30 lbs.	bus. lb. 25 20	bus. lb. 25 4	bus. lb. 22 48	bus. lb. 20 8	bus. lb. 21 4	bus. lb. 22 53	% 101	bus. lb. 13 14	% 104
45 lbs.	25 20	24 0	22 16	18 56	22 48	22 38	100	12 43	100
60 lbs.	23 20	21 44	20 40	21 4	20 48	21 31	95	12 4	95

RATE OF SEEDING EXPERIMENT.

Planted on 19th May, 1933.

Variety—Noongaar.

Superphosphate—90 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1931-33.	Percentage Yields, 1931-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30 lbs.	bus. lb. 16 8	bus. lb. 19 4	bus. lb. 21 36	bus. lb. 19 36	bus. lb. 20 24	bus. lb. 19 22	% 94	bus. lb. 16 18	% 97
45 lbs.	17 4	21 12	22 16	20 8	21 52	20 30	100	16 46	100
60 lbs.	18 32	20 32	22 16	20 16	23 36	21 2	103	16 58	102

The results indicate that little or no advantage is obtained by sowing a mid-season, free-stooling variety at a rate in excess of 30 lbs. per acre or an early, sparse-stooling variety in excess of 45 lbs. per acre.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.
(No. 1.)

Planted on 9th May, 1932.

Variety—Gluyas Early.

Seed—45 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
225 lbs.	bus. lb. 22 48	bus. lb. 21 28	bus. lb. 19 36	bus. lb. 18 24	bus. lb. 18 56	bus. lb. 20 14	% 104	bus. lb. 17 0	% 100
150 lbs.	20 32	19 44	18 56	18 48	19 12	19 26	100	16 56	100
300 lbs.	22 16	21 4	20 0	19 36	19 44	20 32	106	17 25	103

*1930 results discarded.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.
(No. 2.)

Planted on 9th May, 1933.

Variety—Gluyas Early.

Seed—45 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
Nil	bus. lb. 11 52	bus. lb. 12 56	bus. lb. 14 40	bus. lb. 13 12	bus. lb. 14 24	bus. lb. 13 25	% 68	bus. lb. 8 25	% 49
150 lbs.	19 12	20 0	20 16	19 28	19 52	19 46	100	17 21	100
75 lbs.	17 20	17 52	18 40	17 12	17 12	17 39	89	16 50	91

* 1930 results discarded.

The average results indicate that no advantage is derived from applying superphosphate at rates in excess of 150 lbs. per acre. With wheat at its present prices to optimum quantity to apply would appear to be somewhat above 75 lbs. per acre and would probably be in the vicinity of 100 lbs.

SEASONAL PLANTING EXPERIMENT.

April Planting.

Planted on 18th April, 1933.		Superphosphate—90 lbs. per acre					Seed—45 lbs. per acre.		
Variety.	Maturity.	Computed Yields per Acre.					Average Yield per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Bencubbin ..	Midseason ...	21 52	19 28	17 36	21 52	16 40	19 30	106	98
Gluyas Early	Early ...	20 40	18 24	16 40	20 24	16 0	18 26	100	100
Totadgin ...	Early ...	20 56	18 48	16 48	18 56	16 16	18 21	100	100*
Nabawa ...	Midseason ...	18 8	16 0	14 8	17 12	13 20	15 46	80	78
Gluyas Early	Early ...	21 4	20 0	17 52	21 44	18 0	19 44	100	100
Merredin ...	Early ...	21 36	19 28	18 56	20 8	18 40	19 46	100	97
Carrabin ...	Early ...	18 24	17 36	16 8	15 52	15 36	16 43	84	80
Gluyas Early	Early ...	20 56	19 36	20 8	21 36	17 44	20 0	100	100
Noongaar ...	Very Early ...	18 32	14 48	17 12	16 40	14 16	16 18	81	98

* 1932-33

As the winter rains did not commence until late in May, those plots sown in mid-April germinated at the same time as those sown in mid-May.

SEASONAL PLANTING EXPERIMENT.

May Planting.

Planted on 18th May, 1933.		Superphosphate—90 lbs. per acre.					Seed—45 lbs. per acre.		
Variety.	Maturity.	Computed Yields per Acre.					Average Yield per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Geeralying ...	Very Early ...	9 36	12 0	15 20	16 0	13 36	13 18	65	67
Gluyas Early	Early ...	10 12	22 0	21 44	20 0	19 44	20 32	100	100
S.H.J. ...	Early ...	13 28	15 4	16 56	15 28	15 4	15 12	74	70
Bencubbin ...	Midseason ...	21 44	24 0	21 20	23 20	23 28	22 46	113	106
Gluyas Early	Early ...	19 28	20 48	19 36	20 56	20 16	20 13	100	100
Nabawa ...	Midseason ...	21 36	20 32	18 32	20 16	18 48	19 57	99	86
Totadgin ...	Early ...	22 16	21 12	19 52	20 0	18 40	20 24	100	98*
Gluyas Early	Early ...	22 8	20 24	19 4	21 36	19 4	20 27	100	100
Carrabin ...	Early ...	18 56	16 56	16 0	17 20	18 0	17 26	85	87
Merredin ...	Early ...	23 4	22 24	20 56	21 20	23 28	22 14	114	100
Gluyas Early	Early ...	20 16	19 12	18 32	21 12	18 24	19 31	100	100
Noongaar ...	Very Early ...	14 32	14 16	16 40	17 44	18 0	16 14	83	87

* 1932-33.

SEASONAL PLANTING EXPERIMENT.

June Planting.

Planted on 16th June, 1933.		Superphosphate—90 lbs. per acre.					Seed—45 lbs. per acre.		
Variety.	Maturity.	Computed Yields per Acre.					Average Yield per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
Geeralying ...	Very Early ...	14 0	14 48	14 24	13 12	15 36	14 24	94	94
Gluyas Early	Early ...	15 20	15 44	15 12	15 28	15 12	15 23	100	100
S.H.J. ...	Early ...	15 44	18 0	15 52	18 0	15 28	16 37	108	101
Merredin ...	Early ...	17 44	16 24	16 48	14 40	15 28	16 13	100	93
Gluyas Early	Early ...	16 24	16 16	15 44	14 48	17 44	16 11	100	100
Noongaar ...	Very Early ...	17 44	18 0	17 44	17 44	18 56	18 2	111	115

POTASH-NITROGEN EXPERIMENT.

Planted on 26th May, 1933.

Variety—Gluyas Early.

Seed—45 lbs. per acre.

Rate of Application Fertiliser per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Per- centage Yields, 1933.	Average Yields per acre, 1932-33.	Per- centage Yields, 1932-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
112lbs Sulphate of Ammonia	bus. lb. 20 16	bus. lb. 19 28	bus. lb. 19 44	bus. lb. 20 24	bus. lb. 19 36	bus. lb. 19 54	% 105	bus. lb. 19 25	% 103
112lbs. Superphosphate									
112lbs. Superphosphate	19 28	19 4	18 32	19 52	17 44	18 56	100	18 48	100
112lbs. Sulphate of Ammonia									
56lbs. Muriate of Potash	17 12	18 56	18 16	19 52	20 0	18 51	100	19 18	103
112lbs. Superphosphate									

These results indicate only a small increase in yield resulting from the application of sulphate of ammonia. This increase is insufficient to cover the cost of the fertiliser.

YILGARN EXPERIMENT FARM.

Farm Manager, R. W. Priinster.

The monthly rainfalls, as recorded at the farm during 1933, together with the average for the past six years are set out hereunder:—

Year.	Jan.	Feb.	Mar	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1933	20	...	108	39	211	245	120	193	40	50	850	42	70	1,138
Average 6 years ..	35	57	58	77	202	153	110	146	46	59	716	71	57	1,071

The season opened very late, the seasonal winter rains commencing on 21st May. For the first four months of the growing period, falls of above the average were recorded, but for September and October conditions were very dry, although the crops withstood this trying period better than would have been expected.

The land on which the experiments were conducted originally carried salmon gum and odd gimlet timber. It was ploughed with a disc cultivating plough during June and July of the previous year. Late in September it was springtyne cultivated. Sheep were depastured on the fallowed land when necessary to assist in controlling weed growth. Immediately prior to planting the land was again springtyne cultivated.

The results of the field experiments conducted during 1933 are tabulated below:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 19th May, 1933.

Variety—Gluyas Early.

Superphosphate—112 lbs. per acre.

Seed—30 lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percent- age Yields, 1933.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
2 inches	bus. lbs. 17 44	bus. lbs. 15 12	bus. lbs. 16 40	bus. lbs. 16 8	bus. lbs. 14 24	bus. lbs. 16 2	% 98
4 inches	17 52	16 48	16 48	14 32	15 44	16 21	100
6 inches	17 12	17 12	14 48	15 20	14 24	15 47	97

Being for one year only, these results cannot be taken as conclusive. The 4-inch ploughing is certainly more economical than the 6-inch. The disadvantages of too shallow a ploughing such as to a depth of 2 inches include the difficulty of maintaining a suitable mulch and also procuring the desired seed-bed on which the seed is subsequently planted.

MULCHING EXPERIMENT.

Planted on 10th May, 1933.

Variety—Gilyas Early.
Seed—30 lbs. per acre.

Superphosphate—112 lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre. 1933.	Percentage Yields. 1933.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
Cultivated before seeding only	bus. lbs. 15 20	bus. lbs. 14 48	bus. lbs. 15 52	bus. lbs. 17 4	bus. lbs. 18 24	bus. lbs. 16 18	% 97
Cultivated in spring and before seeding	15 4	14 48	17 28	18 0	18 16	16 43	100
Cultivated in spring, during summer after rain and before seeding	15 44	15 28	17 4	18 24	17 52	16 54	101

These results, being for one year only, cannot be taken as conclusive.

The results of many years' experiments, similar to this but conducted at the Merredin Experiment Farm, indicate that the general practice should be to cultivate the fallow during spring and again prior to seeding, and, where the ground is weedy, this cultivation should be supplemented by additional cultivations after rain during the summer months.

TIME OF SEEDING EXPERIMENT.

Variety—Nabawa

Superphosphate—112 lbs. per acre.

Seed—30 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre. 1933.	Percentage Yields. 1933.	Average Yields per acre. 1928-33.	Percentage Yields. 1928-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
18th April	bus. lb. 18 24	bus. lb. 20 32	bus. lb. 20 24	bus. lb. 24 48	bus. lb. 25 36	bus. lb. 21 57	% 95	bus. lb. 19 15	% 101
16th May	20 32	20 48	22 8	26 8	26 16	23 11	100	19 5	100
21st June	9 4	0 20	10 40	8 48	9 52	9 33	41	10 23	54

TIME OF SEEDING EXPERIMENT.

Variety—Gilyas Early.

Superphosphate—112 lbs. per acre

Seed—30 lbs. per acre.

Planted.	Computed Yields per Acre					Average Yields per acre. 1933.	Percentage Yields. 1933.	Average Yields per acre. 1928-33.	Percentage Yields. 1928-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
21st June	bus. lb. 14 16	bus. lb. 14 40	bus. lb. 13 52	bus. lb. 12 40	bus. lb. 13 30	bus. lb. 13 51	% 56	bus. lb. 12 27	% 67
16th May	24 0	24 48	25 12	24 56	23 52	24 34	100	18 41	100
15th July	7 4	5 44	5 20	5 28	6 32	6 2	25	6 37	35

Both this year's results and the average results obtained over the six years that the experiment has been conducted show that it is inadvisable to extend the planting period into the month of June. As indicated in the results it is better to plant a suitable mid-season maturing variety such as Nabawa or Ben-cubbin during the month of April than to plant other wheat varieties after the end of May.

RATE OF SEEDING EXPERIMENT.

Planted on 23rd May, 1933.

Variety—Noongaar.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1931-33.	Percentage Yields, 1928-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
20 lbs.	bus. lb. 18 8	bus. lb. 19 52	bus. lb. 21 28	bus. lb. 21 28	bus. lb. 20 0	bus. lb. 20 11	% 89	bus. lb. 14 18	% 86
40 lbs.	20 8	23 36	24 8	22 32	22 24	22 34	100	16 40	100
30 lbs.	19 36	22 32	22 24	22 40	20 56	21 38	96	15 58	96

RATE OF SEEDING EXPERIMENT.

Planted on 18th April, 1933.

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1931-33.	Percentage Yields, 1931-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
20 lbs.	bus. lb. 18 8	bus. lb. 16 0	bus. lb. 16 52	bus. lb. 15 4	bus. lb. 11 12	bus. lb. 15 15	% 84	bus. lb. 15 3	% 85
30 lbs.	19 52	19 44	18 32	17 44	14 32	18 5	100	17 40	100
30 lbs.	19 20	18 24	17 36	15 32	14 0	16 46	93	17 0	97

Both this year's results and the average results with both the free and the sparse-stooling varieties indicate that the rate of 20 lbs. per acre is insufficient and that the rate of 40 lbs. per acre shows to slight advantage against the rate of 30 lbs. per acre.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 18th May, 1933.

Variety—Gluyas Early.

Seed—30 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1919-33	Percentage Yields, 1919-33
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Nil	15 52	14 40	14 24	12 56	12 32	14 5	61	11 54	64
150 lbs.	24 16	24 24	22 0	22 24	21 44	22 58	100	18 42	100
75 lbs.	20 56	20 48	18 48	18 40	18 48	19 36	85	16 10	86

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 18th May.

(No. 2)

Seed—30 lbs. per acre.

Variety—Gluyas Early.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1919-33*	Percentage Yields, 1919-33*
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
225 lbs.	22 48	22 40	23 28	23 44	23 12	23 10	105	17 13	100
150 lbs.	20 32	22 0	23 4	22 48	22 0	22 5	100	17 10	100
300 lbs.	23 36	24 24	24 8	24 8	24 8	24 5	109	17 22	101

*1932 results discarded.

These results again show that increased yields are obtained when superphosphate is applied up to 150 lbs. per acre.

Under present economic conditions the most economical rate of application appears to be between 100 and 112 lbs. per acre.

SEASONAL PLANTING EXPERIMENT.

Planted on 13th April, 1933.

April Planting.
Seed—30 lbs. per acre.

Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1932-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		
Noongaar ...	Very Early ...	18 32	18 48	10 12	18 56	10 28	18 59	88	68
Gluyas Early ...	Early ...	20 56	21 28	22 8	21 52	21 44	21 38	100	100
Totadgin ...	Early ...	22 8	22 48	22 48	22 16	22 40	22 32	104	106
Bencubbin ...	Midseason ...	22 0	23 36	23 52	23 12	23 20	23 12	107	107
Gluyas Early ...	Early ...	20 48	22 8	21 20	22 32	22 40	21 54	100	100
Nabawa ...	Midseason ...	20 24	21 44	20 24	21 4	22 8	21 9	98	102

SEASONAL PLANTING EXPERIMENT.

Planted on 16th May, 1933.

May planting.
Seed—30 lbs. per acre.

Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1932-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		
Noongaar ...	Very Early ...	21 20	19 44	19 12	20 16	20 0	20 6	94	70
Gluyas Early ...	Early ...	23 4	20 40	20 56	21 20	21 20	21 28	100	100
Geeralyng ...	Very Early ...	22 0	20 16	20 48	18 56	19 44	20 21	95	85
Merredin ...	Early ...	22 48	21 44	22 16	20 0	20 48	21 31	104	96
Gluyas Early ...	Early ...	21 4	20 8	21 52	19 12	20 56	20 38	100	100
Totadgin ...	Early ...	21 52	22 0	22 8	20 40	22 0	21 44	105	108
S.H.J. ...	Early ...	21 20	19 12	18 24	17 12	19 36	19 9	92	91
Gluyas Early ...	Early ...	23 4	19 44	19 44	19 36	21 36	20 45	100	100
Carrabin ...	Early ...	21 4	18 56	18 8	18 32	20 0	19 20	93	97
Bencubbin ...	Midseason ...	24 40	21 52	20 48	23 4	23 44	22 50	110	113
Gluyas Early ...	Early ...	21 44	19 52	19 44	20 40	21 28	20 42	100	100
Nabawa ...	Midseason ...	21 20	20 24	20 56	21 44	22 8	21 18	103	101

SEASONAL PLANTING EXPERIMENT.

Planted on 20th and 21st June, 1933.

June Planting.
Seed 30 lbs. per acre.

Superphosphate—112 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1932-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		
Noongaar ...	Very Early ...	14 40	11 52	10 40	12 40	9 44	11 55	108	109
Gluyas Early ...	Early ...	10 56	10 56	10 56	11 28	11 4	11 4	100	100
Geeralyng ...	Very Early ...	10 24	9 12	8 40	10 24	10 0	9 44	88	90
Merredin ...	Early ...	10 56	9 4	9 44	11 44	11 12	10 32	101	101
Gluyas Early ...	Early ...	12 16	10 16	10 16	12 16	11 12	11 15	100	100
Totadgin ...	Early ...	12 40	10 40	11 36	12 16	12 16	11 54	106	111
S.H.J. ...	Early ...	11 20	9 44	8 24	9 4	10 8	9 44	83	87
Gluyas Early ...	Early ...	11 56	11 52	10 48	10 40	12 8	11 41	100	100
Carrabin ...	Early ...	12 24	9 44	9 36	10 24	10 56	10 37	91	93
Bencubbin ...	Midseason ...	13 4	13 20	13 4	13 4	14 8	13 20	110	116
Gluyas Early ...	Early ...	12 8	12 24	12 16	11 52	11 52	12 6	100	100
Nabawa ...	Midseason ...	10 8	10 32	10 8	11 4	13 28	11 4	91	105

It will be noted that the yields from the June planted plots are well below those from the plots planted during April and May, which indicates the inadvisability of extending the planting period into the month of June.

The germination of the April planted plots was delayed by the lack of early seeding rains and did not take place until after the rains which fell during the early portion of the last week in May, and which also germinated the May planted plots. Consequently the April plots lose their value of comparison with the May plots.

Previous years' experiments have demonstrated the advisability of commencing wheat seeding operations with a mid-season maturing variety such as Bencubbin or Nabawa planted in April. The major portion of the crop should be planted during the first three weeks in May, the main seeding month, with an early maturing variety such as Gluyas Early or Totadgin. Finally, the seeding operations should be completed during the last week of May with the proved early variety of "Noongaar."

POTASH-NITROGEN EXPERIMENT.

Planted on 17th May, 1933.

Variety—Gluyas Early.

Superphosphate—112 lbs. per acre.

Seed—30 lbs. per acre.

Rate of application of Fertiliser per acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
112 lbs. Sulphate of Ammonia; 112 lbs. Superphosphate	bus. lbs. 19 20	bus. lbs. 19 4	bus. lbs. 18 32	bus. lbs. 19 12	bus. lbs. 19 52	bus. lbs. 19 12	97
112 lbs Superphosphate ...	18 32	19 12	*	19 44	21 20	19 42	100
112 lbs. Sulphate of Ammonia; 56 lbs Muriate of Potash; 112 lbs. Superphosphate	18 40	18 56	18 24	19 20	20 24	19 9	97

* Discarded owing to an accident in harvesting.

These results are for one year only and therefore not conclusive. They, however, indicate that the wheat yield at this farm is not increased through the application of either a nitrogenous or a potassic fertiliser.

MERREDIN EXPERIMENT FARM.

Farm Manager, J. H. Langfield.

The following table shows the monthly rainfall as recorded at the farm during the year together with the average over a period of 22 years.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
					May.	June.	July.	Aug.	Sept.	Oct.				Total.
1933 ...	24	...	14	16	160	213	128	149	49	85	784	42	87	967
Av. 22 years	51	52	112	79	137	185	187	152	88	85	834	43	54	1,225

The rainfall from 1st January to 30th April was only 54 points, and although 160 points were registered for May, no rain of any consequence fell until the beginning of the last week of that month. Also, the rainfall for the growing period was 50 points below the average.

The land on which the experiments were conducted originally carried salmon gum and gimlet timber. It was ploughed during June, 1932, with a disc

cultivating plough, reploughed in September, cultivated with a tandem disc cultivator in early October and again cultivated with the disc cultivating plough during November. The continual use of these disc implements was necessary owing to the difficulty of dealing with the strong weed growth.

All plots were springtyne cultivated prior to seeding, and, where necessary owing to later planting, this cultivation was repeated.

The results of field experiments conducted during 1933 are tabulated below:—

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 14th June, 1933.

Variety—Totadgin.
Seed—40 lbs. per acre.

Superphosphate—112 lbs. per acre.

Treatment.	Average Yields per acre, 1933.		Percentage Yields, 1933.	Average Yields per acre, 1925-33.		Percentage Yield, 1925-33.
	bus.	lbs.		bus.	lbs.	
Fallowed	30	40	196	24	38	142
Unfallowed	15	40	100	17	18	100

These results show definitely that decreased yields can be expected when the land has not been fallowed.

TIME FOR PLOUGHING EXPERIMENT.

Planted on 1st June, 1933.

Variety—Totadgin.
Seed—40 lbs. per acre.

Superphosphate—112 lbs. per acre.

Time of Ploughing.	Average Yields per acre, 1933.		Percentage Yields, 1933.	Average Yields per acre, 1930-33.		Percentage Yields, 1930-33.
	bus.	lbs.		bus.	lbs.	
June	30	48	100	30	33	100
July	28	8	91	26	56	88
August	24	0	78	20	59	69

These results emphasise the advantage of early fallow.

MULCHING EXPERIMENT.

Planted on 31st May, 1933.

Variety—Totadgin.
Seed—40 lbs. per acre.

Superphosphate—12 lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1933.	Per- centage Yields, 1933.	Average Yields per acre, 1915-33*	Per- centage Yields, 1915-33*
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		bus. lbs.	
Cultivated in spring, during summer after rain, and before seed- ing	18 10	20 0	20 32	21 12	23 52	20 46	98	21 48	101
Cultivated in spring, and before seeding	16 48	20 16	21 28	22 8	25 36	21 15	100	21 34	100
Cultivated before seed- ing only	15 28	18 48	18 48	19 4	25 28	19 31	92	20 21	94

* Exclusive of 1931

The average results obtained over a period, extending back to 1915, indicate that the general practice should be to cultivate the fallow during spring and again prior to seeding, and where the ground is weedy, this cultivation should be supplemented by additional cultivations after rain during the summer months.

RATE OF SEEDING EXPERIMENT.

Planted on 29th May, 1933.

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1913-33*.	Percentage Yields, 1913-33*.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30 lbs. ...	bus. lbs. 26 8	bus. lbs. 24 16	bus. lbs. 25 30	bus. lbs. 25 38	bus. lbs. 25 20	bus. lbs. 25 22	100	bus. lbs. 19 31	95
45 lbs. ...	23 4	26 24	25 12	23 28	28 0	25 14	100	20 31	100
60 lbs. ...	22 56	25 4	26 24	23 20	28 16	25 12	100	20 35	100

* Excluding 1914.

RATE OF SEEDING EXPERIMENT.

Planted on 8th June, 1933.

Variety—Noongar.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1913-33*.	Percentage Yields, 1913-33*.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
30 lbs. ...	bus. lbs. 28 0	bus. lbs. 26 16	bus. lbs. 27 12	bus. lbs. 26 56	bus. lbs. 26 8	bus. lbs. 26 54	92	bus. lbs. 18 56	96
45 lbs. ...	29 44	27 12	29 36	29 4	29 44	29 4	100	19 42	100
60 lbs. ...	28 32	28 24	31 12	30 24	32 32	30 13	104	19 26	99

* Excluding 1914.

The average results indicate that in this district it is unnecessary to sow either the sparse or the free-stooling varieties at a rate greater than 45 lbs. per acre.

TIME OF PLANTING EXPERIMENT

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
Mid April ...	bus. lbs. 30 8	bus. lbs. 31 4	bus. lbs. 32 0	bus. lbs. 32 16	bus. lbs. 33 4	bus. lbs. 31 42	118	bus. lbs. 24 26	102
Mid May ...	26 48	26 8	27 12	25 44	28 32	26 53	100	23 59	100
Mid June ...	25 12	27 12	27 12	26 24	26 24	26 20	99	19 43	82

TIME OF PLANTING EXPERIMENT.

Variety—Gluyas Early.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
Mid June ...	bus. lbs. 24 0	bus. lbs. 27 12	bus. lbs. 25 28	bus. lbs. 26 56	bus. lbs. 24 0	bus. lbs. 25 31	137	bus. lbs. 22 17	90
Mid May ...	19 36	18 48	21 4	16 48	16 56	18 38	100	24 41	100
Mid July ...	20 16	19 20	18 16	17 28	17 12	18 30	100	14 18	58

Owing to the lateness of the general seeding rains, which did not fall until the end of May, it was not possible to effectively deal with weed growth on the plots planted during April and May. The June planted plots were therefore placed at an advantage, as cultivation subsequent to the rains enabled the

germinating weeds to be destroyed. As a result of this, with the variety "Gluyas Early," higher yields were obtained from the June planting than from the May planting, while with the variety "Nabawa" these two plantings were about equal.

However, consideration of the average results obtained over a number of years shows that, provided weed growth is not feared, it is inadvisable to extend the planting period into the month of June. Should it not be possible to complete the seeding during May, it is preferable to plant a suitable midseason-maturing variety in April.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 31st May, 1933.

Variety—Totadgin.

Seed—40 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933.	Average Yields per acre, 1929-33.	Per-centage Yield, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
75 lbs. ...	bus. lbs. 24 8	bus. lbs. 19 36	bus. lbs. 17 20	bus. lbs. 15 28	bus. lbs. 17 52	bus. lbs. 18 53	87	bus. lbs. 23 48	92
150 lbs. ...	24 16	21 28	17 52	18 8	26 56	21 44	100	25 58	100
NW ...	16 32	13 4	9 52	10 48	16 32	13 22	61	15 18	59

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 31st May, 1933.

Variety—Totadgin.

Seed—40 lbs. per acre.

Rate of Application of Superphosphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933	Average Yields per acre, 1929-33.	Per-centage Yield, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3	Sec. 4	Sec. 5.				
300 lbs. ...	bus. lbs. 27 4	bus. lbs. 27 12	bus. lbs. 28 24	bus. lbs. 24 16	bus. lbs. 28 0	bus. lbs. 26 59	105	bus. lbs. 28 11	105
150 lbs. ...	27 4	26 48	24 18	21 52	28 24	25 47	100	26 44	100
225 lbs. ...	27 52	28 40	26 40	23 12	28 48	27 2	105	27 42	104

This year's experiments and the average results over five years indicate that the rate of superphosphate could be increased with advantage above 75 lbs. per acre.

Although the applications of higher rates of superphosphate give increased yields, the most economical rate under present economic conditions would probably be about 112 lbs. per acre.

SEASONAL PLANTING EXPERIMENT

April Planting.

Planted on 19th April, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933.	Per-centage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
Bencubbin ...	Midseason ...	bus. lbs. 28 32	bus. lbs. 24 24	bus. lbs. 21 28	bus. lbs. 27 12	bus. lbs. 21 52	bus. lbs. 24 42	113	116*
Nabawa ...	Midseason ...	27...56	21 36	18 8	22 24	18 24	21 54	100	100
M. 26 ...	Midseason ...	21 44	16 24	16 8	16 56	13 44	16 50	77	88†
Yandilla King ...	Late ...	18 16	17 4	10 56	11 36	14 24	14 27	63	77
Nabawa ...	Midseason ...	25 20	20 40	20 32	18 48	22 40	22 48	100	100
Sutton ...	Late ...	22 56	18 40	10 32	13 36	15 20	15 40	60	74‡

* 1929-33.

† 1932-33.

‡ 1931-33.

SEASONAL PLANTING EXPERIMENT.

May Planting.

Planted on 16th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Yandilla King	Late ...	10 0	23 44	7 44	14 0	18 56	14 53	62	72
Nabawa	Midseason ...	17 52	33 36	15 4	26 0	27 44	24 3	100	100
Button	Late ...	7 52	17 36	8 24	18 56	19 4	14 22	60	65½
Bencubbin	Midseason ...	22 40	23 36	14 40	32 8	28 32	24 19	108	113½
Nabawa	Midseason ...	24 16	21 12	14 0	28 40	24 48	22 35	100	100
M. 26	Midseason ...	16 48	16 8	11 52	22 8	20 32	17 30	78	72½
Merredin	Early ..	18 56	19 20	14 0	24 48	23 36	20 8	87	108
Nabawa	Midseason ...	22 48	22 16	16 0	27 28	27 20	23 10	100	100
Geerallying	Very early	19 36	17 12	11 36	21 20	21 52	18 19	79	96
Gluyas Early	Early ...	19 36	20 0	13 12	25 20	27 36	21 0	90	107
Nabawa	Midseason ...	23 36	19 4	17 4	27 44	29 36	23 25	100	100
Totadgin	Early ...	25 20	20 16	20 56	27 4	28 56	24 30	105	119½
Carabin	Early ...	21 28	13 12	17 52	23 4	24 24	20 0	82	92
Nabawa	Midseason ...	20 16	17 28	22 48	27 44	28 8	24 20	100	100
M. 35	Early ...	17 20	12 32	16 0	21 36	20 32	17 36	72	77½
S.H.J.	Early ...	10 52	10 24	17 4	21 48	21 20	18 42	78	89
Nabawa	Midseason ...	27 4	12 8	22 40	30 8	27 20	23 52	100	100
Noongaar	Very early	24 48	10 56	20 40	24 16	23 12	20 46	87	99

* 1929-33.

† 1932-33.

‡ 1931-33.

SEASONAL PLANTING EXPERIMENT.

June Planting.

Planted on 10th June, 1933

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre

Variety.	Maturity.	Computed Yields per Acre.				Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Bencubbin	Midseason ...	20 0	23 44	23 12	24 40	22 54	108	115½
Nabawa	Midseason ...	19 20	22 56	21 44	20 32	21 8	100	100
M. 26	Midseason ...	21 28	21 28	22 16	20 16	21 22	101	93½
Merredin	Early ...	24 40	22 28	20 32	21 20	21 28	102	110
Nabawa	Midseason ...	23 4	20 32	22 16	20 0	21 28	100	100
Geerallying	Very early	23 52	21 28	22 24	21 36	22 20	104	99
Gluyas Early	Midseason ...	20 56	23 12	25 28	23 12	24 42	112	110
Nabawa	Midseason ...	22 16	22 8	25 12	20 32	2 66	109	100
Totadgin	Early ...	25 12	24 40	23 28	23 20	24 36	111	121½
Carabin	Early ...	23 36	24 0	25 12	23 0	23 2	102	90
Nabawa	Midseason ...	22 40	23 20	23 28	21 4	22 30	100	100
M. 35	Early ...	20 16	22 8	21 20	19 12	20 44	92	87½
S.H.J.	Early ...	20 48	21 28	23 4	19 4	21 6	96	90
Nabawa	Midseason ...	22 40	21 4	22 32	20 56	21 48	100	100
Noongaar	Very early	26 16	25 36	25 36	24 56	25 36	118	115

Section 5 discarded owing to interference by outside factors.

Lack of early rains retarded the germination of the plots planted in April. They consequently germinated at the same time as the May plots after the heavy rains at the beginning of the last week in that month.

The lateness of these rains also gave the June plots an advantage over the earlier sown plots, as it was possible to destroy weed growth on them prior to planting.

The experiment definitely shows that late maturing wheat varieties such as "Yandilla King" are unsuitable for planting in the Merredin district.

The midseason maturing variety "Bencubbin" has again shown to advantage in all sections.

Of the early maturing varieties, "Totadgin" and "Gluyas Early" have given the most satisfactory yields, while "Noongaar" has again demonstrated its suitability as a very early maturing variety for late planting.

POTASH-NITROGEN EXPERIMENT.

Planted on 2nd June, 1933.

Variety—Totadgin.

Seed—40 lbs. per acre.

Rate of Application of Fertiliser per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1932-33.	Percentage Yields, 1932-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
112 lbs. Superphosphate; 112 lbs. Sulphate of Ammonia	bus. lbs. 29 52	bus. lbs. 29 20	bus. lbs. 28 32	bus. lbs. 27 20	bus. lbs. 27 4	bus. lbs. 28 26	104	bus. lbs. 26 14	101
112 lbs. Superphosphate	28 40	27 52	25 36	27 28	27 36	27 26	100	25 58	100
112 lbs. Superphosphate; 112 lbs. Sulphate of Ammonia; 56 lbs. Muriate of Potash	29 12	27 52	26 56	28 0	27 44	27 57	102	25 45	99

The average results show that no appreciable increase in yield is obtained when an application of superphosphate is supplemented with either a nitrogenous fertiliser or a nitrogenous and a potassic fertiliser.

OAT VARIETY TRIAL.

Hay Yields.

Planted on 20th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per acre, 1933			Percentage Yields, 1933.	Average Yields per acre, 1930-33.			Percentage Yields, 1930-33.
		cwt.	qrs.	lbs.		cwt.	qrs.	lbs.	
Mulga	Early	45	0	0	100	53	0	3	100
Gidgee	Midseason	42	2	8	95	55	1	10	104
Guyra	Midseason	41	2	8	96	47	1	6	91
Mulga	Early	43	0	24	100	51	3	5	100
Mulga	Early	41	0	0	100	49	2	12	100
Palestine	Early	38	3	20	95	43	0	10	87
Burt's Early	Early	42	3	4	92	46	3	19	91
Mulga	Early	46	1	4	100	51	2	4	100

OAT VARIETY TRIAL.

Grain Yields.

Planted on 20th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.		Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1930-33.	Percentage Yields, 1930-33.
		Section 1.	Section 2				
Mulga	Early	bus. lbs. 30 24	bus. lbs. 40 0	bus. lbs. 36 12	100	bus. lbs. 36 27	100
Gidgee	Midseason	27 24	28 0	27 32	77	36 12	99
Guyra	Midseason	31 8	32 16	31 32	95	36 6	98
Mulga	Early	32 8	34 32	33 20	100	37 2	100
Mulga	Early	32 24	36 0	34 12	100	37 18	100
Palestine	Early	30 16	29 8	29 32	87	35 22	95
Burt's Early	Early	29 16	31 0	30 8	78	35 26	91
Mulga	Early	40 32	36 16	38 24	100	39 6	100

This year the standard early maturing variety, "Mulga," has proved to be the best variety for both hay and grain. Its suitability for planting in the eastern wheat belt is shown by the average results obtained over a period of 4 years.

CHAPMAN EXPERIMENT FARM.

The following table shows the monthly rainfalls, as recorded at the farm during 1933, together with the averages over the past 28 years.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sept.	Oct.	Total.			
1933	11	...	93	57	391	551	257	386	135	163	1,883	28	102	2,174
Average, 28 years ...	28	44	65	44	252	426	396	278	161	100	1,613	32	27	1,853

The main seeding rains did not fall until late in May. This delay seriously hindered the destruction of weeds prior to planting, a vital factor in the production of satisfactory yields in this district.

Heavy intermittent rains then fell up to 15th June (877 points being registered within this period), causing the land to become very boggy and further delaying the seeding operations. Good growing conditions, however, prevailed for the remainder of the season.

The land on which the experiments were planted originally carried jam timber and some wattle. It was ploughed to a depth of four inches with a mouldboard plough during August, 1932; springtyne cultivated in spring, again in April, and again prior to planting. Those plots planted after the rain late in May received two cultivations prior to planting.

The following tables show the results of the experiments conducted at the farm during the year.

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 20th June, 1933.

Variety —Bencubbin.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Treatment.	Computed Yields per Acre.				Average Yields per acre, 1933.		Percentage Yields, 1933.	Average Yields per acre, 1929-33.		Percentage Yields, 1929-33.
	Section 1.		Section 2.							
Fallow	bus. 30	lbs. 6	bus. 26	lbs. 36	bus. 28	lbs. 21	88	bus. 16	lbs. 30	104
Non-Fallow	33	8	31	3	32	5	100	15	55	100

For the first four years of the experiment (1929-32) the site has been in the paddocks used for the general farm cropping, where the three-course rotation (fallow, crop, stubble) was practised. Over this period the fallow gave an average increase of 1 bushel 40 lbs. per acre, or 14 per cent. over the non-fallow.

With a view to determining the effect of fallowing on the crop yields on land which had been under pasture for some years, the experiment was this year conducted on land which had not been cropped since 1927, but had been top-dressed with 112 lbs. of superphosphate twice during that period. This top-dressing resulted in a good sward of grasses and clovers which was grazed down each year by stock.

The results this year show an advantage in favour of the non-fallow of 3 bushels 44 lbs., or 12 per cent., but on account of the change in the location of the experiment, the results are not comparable with those of previous years.

This year it was very noticeable that the fallowed plots suffered more from boggy conditions and weed growth than did the non-fallow plots. During the growing period the crop on the fallowed plots was more rank than that on the non-fallow. However, at harvest time very little difference was noticeable in this direction.

Previous experiments, using sulphate of ammonia, at this farm have not shown any decided increased yields as a result of increasing the nitrogen supplies.

No definite conclusion may be drawn from one year's results (1933), but they indicate that other factors besides nitrogen content and moisture conservation (this latter was definitely not a limiting factor) may have an important bearing on crop yields in this and similar districts.

Incidentally the average yield from all the plots was 30 bushels 13 lbs., which is considerably higher than has been obtained on similar soil on this farm.

The results would indicate the advisability of further experiments, with a view to changing the rotation on this farm to include a longer continuous pasture period.

TIME OF PLANTING EXPERIMENT.

Variety—Guyas Early.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933	Percentage Yields, 1933	Average Yields per acre, (8 years).	Percentage Yields, (8 years).
	Sec. 1.	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mid-June	18 52	13 12	13 36	12 32	12 24	13 7	102	12 38	87
Mid-May	11 52	13 52	13 12	13 36	11 36	12 50	100	14 37	100
Mid-July	12 8	12 24	12 0	10 40	13 36	12 10	95	8 29	58

TIME OF PLANTING EXPERIMENT.

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Planted.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1928-33.	Percentage Yields, 1928-33.
	Sec. 1.	Sec. 2	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mid-April	4 32	5 20	6 40	6 56	7 36	6 13	123	9 48	94
Mid-May	4 8	4 24	4 40	5 44	6 24	5 4	100	10 28	100
Mid-June	6 40	6 24	8 0	9 12	10 24	8 8	161	10 30	100

The difference in yields obtained from the Nabawa plots as against similar plantings with Guyas Early is very significant. This is probably due to the quick-growing, early maturing variety competing against weed growth better than the slower-growing, later maturing variety.

The lateness of the seeding rains prevented a satisfactory destruction of the weeds on the plots planted both in April and May. Cultivation after the rain resulted in the better control of weed growth on the plots planted in June. As a result these plots show to advantage against those planted during the preceding months.

The average results over a period of years, however, show that it is of no disadvantage to plant the crop in May, but the results this year emphasise the importance of weed control. Therefore, when weeds are feared, it is advisable to delay seeding until sufficient rain has fallen to germinate the weed seeds. The resulting growth can then be destroyed by cultivation before seeding, which, if necessary, may be delayed until the month of June.

RATE OF SEEDING EXPERIMENT.

Planted on 29th May, 1933.

Variety—S.H.J.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, (10 years)	Percentage Yields, (10 years)
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60 lbs.	bus. lb. 13 12	bus. lb. 12 40	bus. lb. 12 32	bus. lb. 13 20	bus. lb. 14 0	bus. lb. 13 9	103	bus. lb. 16 3	106
45 lbs.	13 4	13 12	11 52	13 4	12 40	12 46	100	15 7	100
90 lbs.	16 24	13 4	14 16	13 44	14 32	14 24	113	16 37	110

RATE OF SEEDING EXPERIMENT.

Planted on 27th May, 1933.

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, (6 years)	Percentage Yields, (6 years)
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60 lbs.	bus. lb. 13 12	bus. lb. 14 24	bus. lb. 12 24	bus. lb. 12 16	bus. lb. 14 56	bus. lb. 13 26	117	bus. lb. 15 11	101
45 lbs.	11 4	13 4	10 8	11 52	11 28	11 31	100	14 50	100
90 lbs.	14 48	14 8	12 40	13 4	16 32	14 14	124	16 6	108

Both this year's results and the average results obtained over a long period of years indicate that it is advisable to plant at least 60 lbs. of seed wheat per acre at this farm. This may be influenced by the wetter climatic conditions in addition to the excessive weed growth.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 24th May, 1933.

Variety—Nabawa.

Seed—60 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
NU	bus. lb. 10 16	bus. lb. 10 8	bus. lb. 10 8	bus. lb. 10 16	bus. lb. 11 29	bus. lb. 10 27	89	bus. lb. 10 28	78
150 lbs.	12 0	12 8	11 28	11 52	11 20	11 46	100	13 29	100
75 lbs.	12 8	11 52	11 36	10 56	11 44	11 39	99	12 20	91

Planted on 24th May, 1933.

Variety—Nabawa.

Seed—60 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1933	Percentage Yields, 1933.	Average Yields per acre, 1929-33.	Percentage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
300 lbs....	13 4	13 4	12 16	12 40	12 16	12 40	101	14 15	105
150 lbs....	13 4	12 56	12 32	12 16	12 8	12 35	100	13 31	100
225 lbs....	12 24	12 48	10 48	11 20	12 48	12 2	96	13 51	102

The average results obtained over a period of five years indicate that the rate of superphosphate could be increased with advantage above 75 lbs. per acre.

Although applications of higher rates of superphosphate give increased yields, the most economical rate under present economic conditions would probably be about 100 lbs. per acre.

SEASONAL PLANTING EXPERIMENT.

April Planting.

Planted on 18th April, 1933.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Bencubbin ...	Midseason ..	11 20	7 36	8 40	8 16	5 28	8 16	116	144*
Nabawa ...	Midseason ..	7 44	6 16	7 44	8 8	5 52	7 9	100	100
Baroota Wonder	Midseason ..	7 20	5 12	6 32	4 56	4 8	5 38	79	109†
Sutton ...	Late ...	9 36	6 56	7 4	5 28	6 8	7 2	85	108*
Nabawa ...	Midseason ..	9 36	7 4	8 56	8 8	7 28	8 14	100	100
Yandilla King	Late ...	5 52	4 16	3 44	4 8	4 24	4 20	54	80

* 1930-33

† 1928-29 and 1932-33.

SEASONAL PLANTING EXPERIMENT.

May Planting.

Planted on 17th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Noongaar ...	Very Early ..	13 36	12 40	11 44	13 4	12 56	12 48	115	87
Nabawa ...	Midseason ...	12 56	9 52	10 56	11 52	10 0	11 7	100	100
Yandilla King	Late ...	8 48	6 24	7 12	8 56	8 16	7 55	71	89
Sutton ...	Late ...	11 4	9 20	12 8	12 32	13 44	11 46	112	114*
Nabawa ...	Midseason ...	9 12	9 20	11 4	12 16	10 32	10 29	100	100
Baroota Wonder	Midseason ...	6 32	5 44	6 32	7 52	6 24	6 37	63	96†
Bencubbin ...	Midseason ...	10 48	9 12	11 44	13 12	11 52	11 22	110	116*
Nabawa ...	Midseason ...	10 56	9 20	9 28	12 24	9 20	10 18	100	100
Geeralying ...	Very Early ...	9 44	8 48	9 36	10 16	13 4	10 18	100	99
Totadgin ...	Early ...	11 20	9 36	11 4	13 12	11 52	11 25	104	116‡
Nabawa ...	Midseason ...	11 20	10 0	10 0	13 4	10 16	10 56	100	100
Comeback ...	Early ...	9 28	7 20	7 44	9 36	11 44	9 10	84	84§
Carrabin ...	Early ...	13 4	9 44	11 36	15 12	18 40	13 30	122	101
Nabawa ...	Midseason ...	10 56	9 12	9 36	13 4	13 4	11 10	100	100
S.H.J. ...	Early ...	11 28	10 16	11 12	13 20	15 12	12 18	110	102
Merredin ...	Early ...	8 16	7 36	9 20	9 28	12 16	9 23	80	97
Nabawa ...	Midseason ...	10 24	10 0	12 8	12 56	13 28	11 47	100	100
Gluyas Early	Early ...	9 12	8 48	10 40	10 8	13 4	10 22	90	98

* 1930-33.

† 1928-29 and 1932-33.

‡ 1932-33.

§ 1929-33.

SEASONAL PLANTING EXPERIMENT.

June Planting

Planted on 20th June, 1933.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Percentage Yields, 1928-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Noongaar ...	Very Early ...	11 28	21 4	23 4	24 16	21 52	20 21	108	86
Nabawa ...	Midseason ...	7 28	18 56	21 12	25 4	21 36	18 51	100	100
Sutton ...	Late ...	7 4	18 8	19 4	23 36	18 40	17 8	92	95†
Bencubbin ...	Midseason ...	6 16	19 4	20 24	25 20	18 56	18 10	100	103*
Nabawa ...	Midseason ...	6 24	20 16	20 8	26 40	17 28	18 11	100	100
Comeback ...	Early ...	11 12	15 52	15 36	19 28	14 24	15 28	84	78*
Totadgin ...	Early ...	11 44	17 20	15 12	18 32	13 12	15 12	74	71†
Nabawa ...	Midseason ...	13 4	23 44	20 32	25 20	20 8	20 34	100	100
Georallying ...	Very Early ...	12 56	19 44	18 32	20 16	20 16	18 21	90	90*
Carrabin ...	Early ...	16 8	22 24	17 28	24 8	24 24	20 54	98	92*
Nabawa ...	Midseason ...	16 8	24 24	16 24	23 12	26 24	21 18	100	100
S.H.J. ...	Early ...	17 20	23 52	17 4	22 32	25 28	21 15	100	93
Merredin ...	Early ...	17 4	19 44	17 4	18 40	23 44	19 15	87	89
Nabawa ...	Midseason ...	17 28	23 20	23 52	20 16	26 8	22 13	100	100
Gluyas Early	Early ...	17 52	10 36	20 48	18 48	21 52	10 47	89	89

* 1930-33.

† 1932-33.

Excessive weed growth reduced the yields in both the April and May plantings. Cultivation subsequent to heavy rains which fell towards the end of May enabled the germinating weeds on the June plots to be dealt with more effectively. The result was that considerably higher yields were obtained from these plots than from those of the earlier plantings.

In view of the climatic conditions which prevailed this year, it would be unwise to draw any definite conclusions as to the merits of any one variety.

The results of these seasonal variety trials, together with the experience obtained from the bulk crops, indicate that where weed growth is a factor influencing crop yield, it is essential to delay seeding until sufficient cultivations after the rains have destroyed these weeds. Where boggy conditions prevail from excessive rains, it may be necessary to further delay seeding, and sow those varieties suitable for that time. Under these conditions it would be necessary for farmers to have a percentage of early varieties over and above their requirements for the area they contemplate sowing.

POTASH-NITROGEN EXPERIMENT.

Planted on 27th May, 1933.

Variety—Nabawa.

Superphosphate—112 lbs. per acre.

Seed—60 lbs. per acre.

Rate of Application of Fertiliser per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1932-33.	Percentage Yields, 1932-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
112 lbs. Sulphate of Ammonia	14 16	13 4	13 4	13 20	13 4	13 22	115	11 34	112
112 lbs. Superphosphate									
112 lbs. Superphosphate	11 44	11 12	12 8	10 32	12 16	11 34	100	10 21	100
112 lbs. Sulphate of Ammonia	12 20	12 56	13 52	13 28	14 0	13 31	117	11 52	115
112 lbs. Superphosphate									
56 lbs. Muriate of Potash									

These results indicate that a small increase in yield can be expected when a nitrogenous fertiliser is applied, and also a slightly larger increase when both a nitrogenous and a potassic fertiliser is applied in addition to superphosphate. These increased yields, however, would not cover the increased cost of such fertilisers.

FARMERS' FIELD TRIALS.

A. S. Wild, Agricultural Adviser.

Wheat Variety Trial at Karlgarin.

The wheat variety trial conducted during 1933 on the property of Mr. L. J. Grant, of Karlgarin, was located about a mile distant from the townsite on the main road to Hyden.

Six years previously the land had been cleared of its salmon, mallee and gimlet timber, the 1933 crop being the fourth. The ground had been prepared for the experiment by ploughing 3 inches deep early in July with a disc plough. It was then springtyne cultivated in August, again in September and again in March after rain. The plots were planted on the 12th and 13th of May with a combined cultivator-drill to which light drag harrows were attached.

The following are the monthly rainfalls as recorded at Karlgarin during the year, together with the average rainfall.

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.	
					May.	June.	July.	Aug.	Sept.	Oct.				Total.
1933	38	12	105	44	187	186	121	177	60	86	817	17	33	1,126
Average 1925-32 ...	40	32	143	73	146	174	256	171	131	98	976	65	32	1,361

Prior to planting, rain, sufficient to ensure a satisfactory germination on the type of soil under test, had fallen. This also enabled the young wheat plants to make a fairly vigorous early growth and consequently to better withstand the dry conditions experienced later in the season.

The following table shows the results obtained from the experimental plots, each of which was half an acre in area:—

Planted -12th May.		Rate of seed 45 lbs. per acre.		Rate of 22% Superphosphate 112 lbs. per acre	
Variety.	Maturity.	Computed Yield per Acre.		Average Yield per acre.	Percentage Yield.
		Section 1.	Section 2.		
		bus. lbs.	bus. lbs.	bus. lbs.	%
Nabawa	Midseason	20 26	23 10	21 48	98
Gluyas Early	Early	21 32	22 54	22 13	100
Bencubbin	Midseason	29 34	26 50	28 12	127
Totadgin	Early	26 0	26 16	26 8	118
Gluyas Early	Early	20 44	23 32	22 8	100
Merredin	Early	21 12	25 22	23 17	105
Geeralying	Very Early	21 26	22 28	21 57	103
Gluyas Early	Early	20 34	21 56	21 15	100
Noongaar	Very Early	16 18	17 24	16 51	79
S.H.J.	Early	20 28	16 48	18 38	84
Gluyas Early	Early	22 28	22 6	22 17	100
Carrabin	Early	21 16	19 18	20 17	91

These results indicate the suitability of "Bencubbin" as a midseason-maturing variety and "Totadgin" as an early variety. The varieties "Nabawa," "Gluyas Early," "Merredin," and "Geeralying" also gave satisfactory results. Unfortunately, the yields of the last-named variety were considerably reduced owing to shedding. The "Noongaar" plots suffered severely from the effects of lodging, owing to too early maturity and stormy weather conditions late in the season.

Light Lands Experiments at Gnowangerup.

During 1933 experiments were conducted on the property of Mr. R. M. Waterson, of Gnowangerup, with a view to determining what factors limit the yields of wheat crops on the light land of the district. The experiments consisted of Time of Planting Experiment (April, May and June)—using two varieties, Nabawa, representing the midseason varieties, and Yandilla King, the late varieties—and also a rate of Superphosphate Experiment.

The experimental plots were located about three miles north of Gnowangerup along the main road to Kwobrup. The land, which consisted of a sandy soil over an infertile clay close to the surface, originally carried scrub and mallee and was in crop for the second time. It was disc ploughed 2½ inches deep during June and early July, disced 2 inches deep in September and again in February. Immediately prior to seeding each plot was harrowed.

The following are the rainfalls as recorded at Gnowangerup during the year, together with the average:—

Year.	Growing Period.										Total	Nov.	Dec.	Total for year.
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.				
1933	114	11	78	26	154	428	102	121	110	243	1,158	62	51	1,500
Average 20 years to 1932	56	82	88	158	227	223	232	193	178	148	1,201	67	71	1,723

The yields from the plots are set out below:—

TIME OF PLANTING EXPERIMENT.

Variety—Nabawa.

Rate of Seed—45 lbs. per acre.

Rate of 22% Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yield per Acre.		Average Yield per acre.	Percentage Yields.
	Section 1.	Section 2.		
	bus. lbs.	bus. lbs.	bus. lbs.	%
April 19th	10 28	10 20	10 24	99
May 18th	10 30	10 28	10 29	100
June 16th	9 48	11 40	10 44	102

Variety—Yandilla King.

Rate of Seed—45 lbs. per acre.

Rate of 22% Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yield per Acre.		Average Yield per acre.	Percentage Yields.
	Section 1.	Section 2.		
	bus. lbs.	bus. lbs.	bus. lbs.	%
April 19th	10 10	10 4	10 7	100
May 18th	9 0	11 14	10 7	100
June 16th	10 52	10 44	10 48	107

RATE OF SUPERPHOSPHATE EXPERIMENT.

Planted—19th May.

Variety—Yandilla King.

Rate of Seed—45 lbs. per acre.

Rate of 22% Superphosphate—120 lbs. per acre.

Rate of 22% Superphosphate.	Computed Yield per Acre.		Average Yield per acre.	Percentage Yields
	Section 1.	Section 2.		
75 lbs.	bus. lbs. 10 0	bus. lbs. 9 9	bus. lbs. 9 35	% 90
150 lbs.	10 36	10 51	10 43	100
225 lbs.	11 24	10 30	10 57	102

The results of the Rate of Superphosphate Experiment indicate that 75 lbs. of superphosphate per acre is not sufficient for this class of soil and that higher yields may be expected from applications of larger amounts.

Having regard to the satisfactory working of the land and the season, the low yields obtained, even when the time of planting, the variety and the rate of superphosphate are varied, indicate that the infertility for wheat growing is due to some other factor. Field observations appear to indicate a nitrogen deficiency, but this evidence is not conclusive.

PASTURE NURSERY PLOTS.

G. K. BARON-HAY, Superintendent of Dairying,
and

H. G. ELLIOTT, Agricultural Adviser.

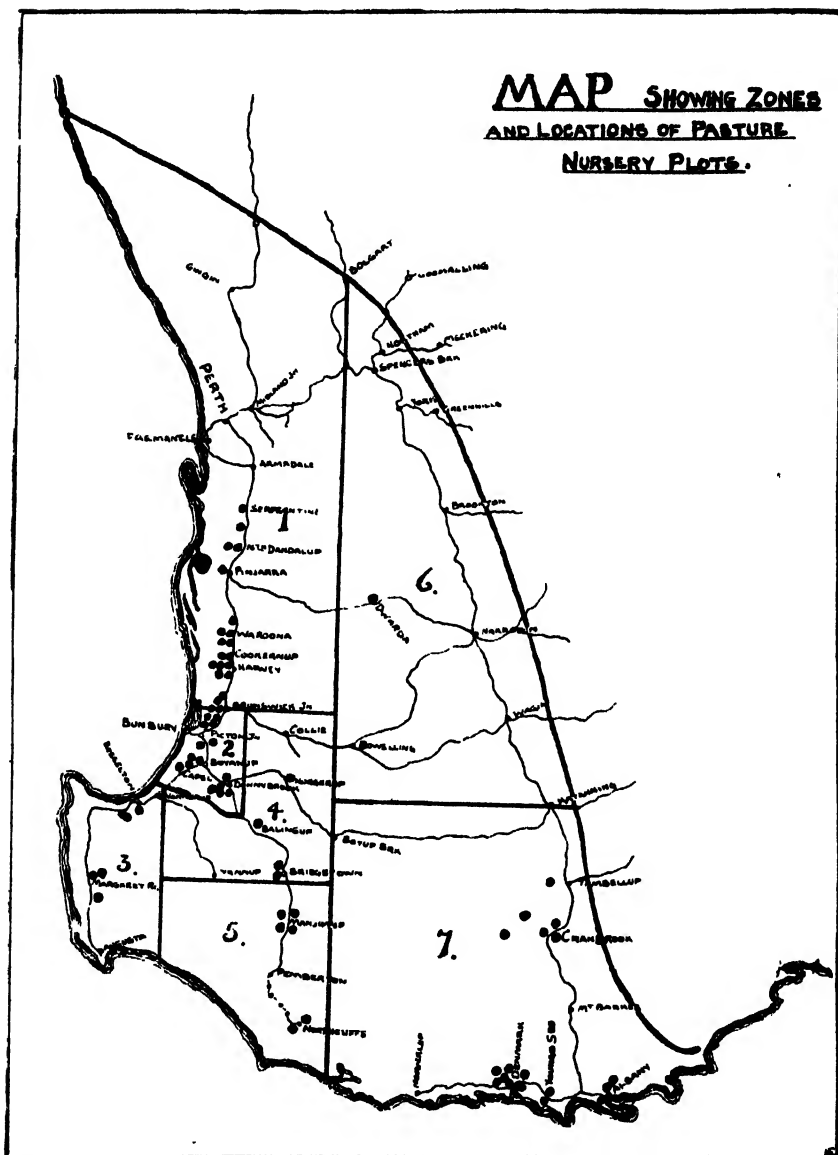
The pasture nursery plots which were conducted last season in the various districts of the State by Cuming Smith & Mt. Lyell Farmers' Fertilisers Ltd. in close co-operation with the Department of Agriculture were continued during 1933-34.

The attached map shows the South-West portion of the State divided into seven zones in each of which a number of nursery plots have been instituted.

It was hoped that, where any fodder plant should prove specially suitable to a district, these nursery plots would be used for the purpose of gathering seed which could be sown on larger areas and in a number of cases this has been done during the season just completed. Each series consisted of three plots—each 1/20th of an acre in extent, the plots being sown as follows:—

- (a) Western Districts Perennial Rye Grass 20 lb. per acre.
New Zealand White Clover 2 lb. per acre.
- (b) Akaron Cocksfoot 20 lb. per acre.
New Zealand White Clover 2 lb. per acre.
- (c) Phalaris tuberosa 10 lb. per acre.
New Zealand White Clover 2 lb. per acre.

Fertiliser.—All plots were fertilised at planting with super and ammonia No. 3 at the rate of 300 lb. per acre, and again in April, 1933, with the same fertiliser.



The following are the results after the second season's growth, each zone being treated separately—

ZONE 1.

Centre—Waroona. Rainfall—30-40 inches.

Twenty plots were established in 1932, 14 being continued through 1933.

Perennial Rye Grass.—The germination of rye grass was exceptionally good on all plots, the average being 85 to 90 per cent. Approximately 60 per cent. of the total sowing persisted through the first summer and grew in the second year. The growth, however, was not healthy, the grass being yellow and not vigorous

even after an application of 300 lb. super and ammonia No. 3 per acre. On the irrigated areas, however, the growth was very promising.

Cocksfoot.—Germination approximately 45 per cent. the first year, only 30 per cent. surviving the first summer. This grass is unsuitable for the average unirrigated land in Zone 1.

Phalaris tuberosa.—Approximately 56 per cent. germination which is considered satisfactory for this grass. Persistency during the first summer was high, being approximately 70 per cent.

A number of plots have not been well prepared, resulting in weed growth which probably affected the persistency.

This grass is without doubt the most outstanding one in the trials, showing a vigorous healthy growth during the second year and producing a bulk of feed throughout the season.

New Zealand White Clover.—In almost all plots this clover was a failure, due to attacks by the red mite and lucerne flea.

It is probable that the only areas where this clover will succeed are those that are irrigated and where spring planting may be practised in order to avoid attacks by the above pests.

ZONE 2.

Centre—Burekup. Rainfall—40 inches.

Eighteen plots were established in this zone in 1932, 15 being continued during 1933. All plots were top-dressed in April with 300 lb. super and ammonia No. 3 per acre.

Perennial Rye Grass. Average germination good (85 per cent.), approximately 60 per cent. surviving through the first summer.

The plots, generally, were of an unhealthy green colour, but in three instances—on alluvial soil—good results were being obtained.

This grass is not recommended except on the richest soils.

Akaroa Cocksfoot.—Germination approximated 70 per cent., the carry over, however, during the first summer being very low.

This grass is quite unsuited for average conditions in Zone 2.

Phalaris tuberosa.—Germination and growth were slow during the first year and, it was thought, disappointing. During the second year, this grass was outstanding, approximately 90 per cent. of those plants which germinated living through the summer.

On two plots where weed competition was great in the early stages, the young *Phalaris* plants were smothered.

The most promising perennial yet tried for Zone 2.

White Clover.—As in zone 1, this clover is generally a failure when sown in the autumn, owing to attacks by red mite and lucerne flea. Only one plot was successful. On irrigated areas, however, where spring sowing can be practised, good results are obtained with this plant.

ZONE 3.

Centre—Margaret River. Rainfall—30-40 inches.

Five plots were established in 1932, and were continued in 1933 after receiving a top-dressing in April with super and ammonia No. 3, at the rate of 300 lbs. per acre.

Perennial Rye Grass.—The average germination was high (80 per cent.), of which 60 per cent. persisted through the first summer.

This grass was not a success, particularly owing to water-logging of the country, and no adequate drainage system being adopted.

Cocksfoot.—Below Margaret River, on good land, this grass has possibilities, but was not a success on all plots, partly owing to faulty soil preparation and excessive weed growth.

Phalaris tuberosa.—Sixty per cent. germination, and of this approximately 60 per cent. survived the first summer. The growth, however, in Zone 3 has not been equal to that in Zones 1 and 2.

White Clover.—On only one plot was this clover successfully established. This plot was on new ground, free from red mite and lucerne flea. The other plots were a failure, due to insect pests.

ZONE 4.

Centre—Donnybrook. Rainfall—30 inches.

Three plots were continued during 1933, being top-dressed in the autumn with 300 lbs. super and ammonia No. 3 per acre.

Perennial Rye Grass.—The germination of all plots was good (75 per cent.), the persistency also being higher in this zone than in any other areas (70 per cent.).

A further trial is warranted with this plant in this area before definite advice can be given.

Cocksfoot.—As in the previous areas, cocksfoot did not withstand the dry summer conditions, only odd plants persisting.

Phalaris tuberosa has given good results in this zone, remaining green during the summer and providing green grazing. A very promising perennial.

White Clover.—Germination was good, but severe attacks from the red mite and lucerne flea resulted in general failure.

ZONE 5.

Centre—Manjimup. Rainfall—30-40 inches.

Five plots were established in 1932, four being continued through 1933.

Perennial Rye Grass.—In this zone perennial rye grass gave the best results of the three grasses planted. Persistency was high, and the grass appeared healthy in colour.

Cocksfoot.—In three plots the growth of cocksfoot and its persistency were good. With the advent of autumn rains this grass provides an "early bite." It is a grass that probably would succeed in this zone.

Phalaris tuberosa.—Very disappointing results were obtained with this grass in the first year, being partly due to water-logging and excessive weed competition. Of those plants which have survived, approximately 50 per cent. grew healthily during the second year.

A further trial is warranted before any definite information can be given.

White Clover.—Better results in this zone than in any other district. Persistency was good, and showed up well during the second season.

ZONE 6.

Centre—Dwarda. Rainfall—24 inches.

Perennial Rye Grass.—The germination of rye grass was excellent (85 per cent.), but only 25 per cent. persisted after the first year. It cannot be recommended for this zone.

Cocksfoot.—A germination of approximately 65 per cent. was obtained, but only a few plants persisted during the summer. Unsuitable for Zone 6.

Phalaris tuberosa.—Germination was good, persistency being approximately 30 per cent. This is the only grass giving any promise of success in Zone 6.

White Clover.—Good germination was obtained, but no plants persisted through the summer months. Unsuitable for Zone 6.

ZONE 7.

Tambellup to Denmark. Rainfall—20-40 inches.

Seventeen plots were established in 1932, 13 being continued during 1933.

This zone covers a wide variation in climate and also in soil type, and an endeavour was made to spread the plots over as wide a range as possible.

Perennial Rye Grass.—The germination throughout was exceptionally good—up to 85 per cent., and in the Southern districts a very high percentage of drought resistant plants was noticed. The colour generally, however, was not healthy except where liberal supplies of nitrogen were available.

This grass undoubtedly will become one of the main pasture plants in the extreme south coastal belt as land becomes more fertile.

Cocksfoot.—In the high rainfall areas and on light loamy slopes growing karri, cocksfoot has done exceptionally well. In low-lying wet areas it was persistent, but not producing any bulk.

Germination was fair—50 to 60 per cent. with a high percentage of persistency—a useful grass in this zone.

Phalaris tuberosa.—Throughout the whole of Zone 7 and under all soil conditions tried, this grass has given the most promising results. During the first year the growth was disappointing, but those plants which grew proved very persistent and have grown well during the second year.

A grass that can be confidently recommended in this zone, provided proper preparation of the seed bed is carried out.

New Zealand White Clover.—Only in the southern areas of Zone 7 has this clover proved successful. Where, however, red mite or lucerne flea exists, autumn planting is fatal. Provided these pests are not present, white clover may be included in all seed mixtures along the southern coast.

AREAS NORTH OF PERTH.

Four plots were established in 1933 north of Perth, namely, at Gingin, Moora, Walebing, and Irwin through the courtesy of Cuming Smith and Mt. Lyell Farmers Fertilisers, Limited. The same seed mixtures were used as in other areas.

"PINK EYE" OPHTHALMIA IN SHEEP.

A. McK. CLARK, L.V.Sc.,
Chief Veterinary Surgeon.

In view of the prevalence of "pink eye" or ophthalmia in sheep during this period of the year, and in response of several requests, the following article is reprinted from the "Journal of Agriculture" of September, 1932. It is also available as a leaflet at the Department of Agriculture.

This disease is caused by a germ infection of the outer covering of the eyeball, and is seasonable in its occurrence. It appears generally during the summer months, and is mostly associated with travelling sheep. The movement of sheep from one place to another facilitates its spread owing to its infectious character. When occurring on farms it causes a loss of condition in sheep, but apart from that no other economic loss eventuates. The casual germ is carried from one sheep to another by means of flies, etc.

Symptoms.—The affected sheep will be firstly noticed in their inability to follow the mob. When being driven singly the head is held erect as if the animal is endeavouring to hear in order to discover its direction. When standing quietly the head is held low in order to avoid light. In the early stages of this disease the eye or eyes are noticed discharging water freely. On examination the eye will appear deeply injected or "blood shot." From this the name is derived—"pink eye." The eye will be noticed free from foreign bodies, such as grass seeds, etc. The eye gradually becomes worse and the lids become gummy. The eyeball itself becomes opaque at a later stage. It even loses its oval shape and becomes pointed in front. It is at this stage that the animal begins to lose condition, and if affected in both eyes even runs into obstacles or water holes and becomes drowned. The disease gradually spreads to all sheep in close contact, but usually only one eye is affected.

If proper treatment is provided the sheep will gradually recover their eyesight, and spread of the disease to other sheep will be prevented. In this connection it might be as well to remind sheep-owners that it is an offence under the Stock Diseases Act to sell sheep affected with any infectious disease. The only way to avoid "Pink Eye" is to—

- (1) refuse to purchase sheep from known infected flocks;
- (2) examine fresh purchases and isolate them for a week, or until satisfied that they are free from disease. This is a wise procedure with all fresh purchases of live stock. If the flock is already infected remove the infected sheep into a well-shaded homestead paddock, and hand-feed and water to prevent the serious loss of condition, which will otherwise occur. The eyes of these sheep should be treated daily with the following lotion:—

Sulphate of zinc—10 grains.

Extract Balladonna—10 grains.

Water which has been boiled and allowed to cool—1 pint.

All discharges from the eyes should be removed with cotton wool, before using the eye lotion. The lotion must not be made up overstrength, or permanent damage may be caused to the eye. If unable to get the lotion made up, the following lotion may be used instead:—Boracic acid, one teaspoonful, dissolve in a little hot water in a cup. Get a clean beer bottle which has previously been rinsed out

with hot water, and fill to neck with warm water which has been previously boiled, then add boracic acid solution. Shake before using. Sheep which are showing an opacity of whiteness of the cornea may be treated with the following lotion:—

Silver nitrate—1 dracham.

Water which has been boiled—1 pint.

A camel hair brush or a fountain pen filler are useful to apply the lotion, or a clean new oil can.

Every morning early the healthy sheep should be inspected to pick out the fresh cases, and these should be removed to the isolation paddock. As the sheep recover they should be put into another paddock, and not allowed to mix with the healthy sheep until all danger of infection has ceased. The sheep usually recover their sight fully and the infection will disappear in time, but the loss of condition is nearly always severe, and the amount of extra work involved in handling the flock or moving them about is often enormous.

An experiment carried out recently at the Veterinary Laboratory proved that this disease is infectious. Work is also being carried out to find out the casual organism, and if possible, to produce a vaccine which will prevent infection.

PASTURE COMPETITION—DONNYBROOK DAIRY FARMERS' ASSOCIATION.

M. CULLITY, B.Sc. (Agr.),

Agricultural Adviser, Dairy Branch.

This competition, organised by the Dairy Farmers' Association of Donnybrook, commenced with an inspection carried out in January, 1933. The present competition was judged on the same scale of points as that to be used for a major competition just commencing, which will continue over three years.

The scale of points was as follows:—

Permanency	..	..	..	..	..	..	30
Feed Value	..	..	..	..	..	..	25
Cultivation and Freedom from Weeds, etc.	..	..	..	..	..	..	10
Experimental Value	..	..	..	..	..	..	10
Bulk	..	..	..	..	..	..	25
Total	..	..	..	..	..	..	100

The following farmers' plots were inspected during January, May, and November:—

J. Egan.

J. G. Fry.

A. Trigwell.

B. Langridge.

R. J. Trigwell.

J. Hearman.

The dates of inspection were arranged so that the areas would be seen (a) at the dry season in order to assess the amount of summer grazing, etc., (b) after the first rains in order to note the proportion and vigour of any perennials present and also to note the effect of the cultural and manuring operations carried out. (c) at time of maximum growth.

The points allotted to each entrant were as under:—

Name.	Permanency. (30)	Feed Value. (25)	Cultivation and Manuring. (10)	Experi- mental Value. (10)	Bulk. (25)	Total Points. (100)
J. Egan	25	25	8	5	25	88
A. Trigwell	24	25	6	6	20	81
R. J. Trigwell	20	21	8	10	18	77
B. Langridge	20	19	9	10	19	77
J. G. Fry	23	23	8	4	18	76
J. Hearnan	23	20	6	4	16	69

During judging the following points were considered:—

Permanency—

- (a) Considered as lasting from season to season without resewing;
- (b) as providing green grazing for the whole year—summer and winter;
- (c) as the percentage of perennial plants present.

The ideal permanent pasture would be one on which there would be ample succulent grazing in all seasons. In our climate this is possible only on small localised areas. A pasture which gives growth during a certain portion of the year only, may be considered permanent when reseeding is not necessary. This type of pasture may be annual or perennial, the annual one having this effect of permanency when its seeding habits enable it to persist, e.g., subterranean clover. Where perennial plants were present, however, an advantage was gained, as these usually result either in earlier and more vigorous growth in the autumn and a longer growing season where the plant is a winter and spring grower, or else summer grazing where summer conditions suit that plant.

The degree of fertility of the soil is an important factor in allowing the usual perennial plants to persist in a pasture. The common perennials are usually high fertility loving plants and do not last in areas of comparative low fertility. Where it is desired to carry out trials with these plants, more fertile sections should be selected for them. If persistence is not obtained in these soils, it may be assumed with safety that trials on soils of lower fertility will not be successful. If farmers keep this point in view, much money will be saved by avoiding at the moment hopeless experimentation.

Feed Value.—This section proved difficult to interpret. When considered from a viewpoint of total nutrients in the absence of facilities for obtaining average analyses of each plot, recourse would have to be made to standard analysis of each plant, and these are so nearly alike that the section would resolve itself to a duplication of that of bulk. For example the following are quoted from Henry and Morrison, T. N. (digestible):—

Perennial Rye (hay)	47
Lucerne hay (all analyses)	51.6
Sudan hay	51.4
Lucerne, after bloom	16
Perennial Rye (green)	15.8

In view of this difficulty, recourse was made to judging this section by considering:—

- (a) The estimated carrying capacity;
- (b) the general attractiveness of the pasture, including vigour, palatability, etc.; and
- (c) the mixture of grasses and clovers present.

It is accepted that a mixture of grasses and clovers is advisable for several reasons, one of which is to enable the stock to maintain a balance in diet by providing a variety of protein and by providing variety which will stimulate the appetite and increase the digestibility. Palatability is a most important factor and one that must be considered. Increased bulk at the cost of decreased appetite in the stock may not be profitable. Palatability also varies gradually with the fertility of the soil, but this fact does not affect the judging greatly in this competition. The variety of plants present also was considered because stock show partiality to some grasses in preference to others, and there is some variation according to the stage of growth. Further, all plants do not require the same quantities of soil constituents, so that what is not used by one may be taken up by another. An excellent example is furnished by the growing together of a clover and a grass. The clover actually leaves more nitrogenous matter ready for absorption in the ground than it can use. This additional nitrogen is readily used by grasses which may be sown.

Cultivation and Manuring.—Consideration was given to the suitability of the cultural operations carried out and also to the neglect of cultivation where this would have proved useful. Manuring was studied also from a standpoint of suitability.

Experimental Value—Consideration had to be given to both positive and negative values, that is, not only were points allotted for excellent ideas in the establishment of pastures but also to the demonstration that certain ideas that might be popularly accepted would not stand in practice.

Reference may be made again to the fertility factor in controlling the type of plant that will exist.

Points for Bulk were given according to the estimations made at the final judging when actual weights were taken and also to the comparative growths on the plots when inspected during the year.

Comments on the pastures inspected follow:—

J. Egan.

The soil was of a varied nature containing clay, loam and sand. The original pasture consisted of kikuyu, subterranean clover, drooping flowered clover, soft brome, silver grass, and spear grass. On this, without cultivation, the following was sown on 6/5/31:—

Phalaris tuberosa	5 lb.
Cocksfoot	2 lb.
Perennial Rye Grass	2 lb.
Tall Fescue	2 lb.

This was topdressed with 100 lb. superphosphate per acre in May, and 25 lb. sulphate of ammonia in August.

When inspected in January, 1933, it was estimated that it would yield 15 tons of green material per acre, being a particularly high dense growth. In

May, 1933, the pasture was quite vigorous, but very little could be seen of the *phalaris tuberosa*, perennial rye, or cocksfoot. In November, 1933, the growth was again very dense and yielded 12.8 tons of green material per acre, being mostly kikuyu, drooping flowered clover, spear grass, and subterranean clover. Only odd plants of *phalaris tuberosa* could be seen.

B. Langridge.

Soil—heavy red clay loam sown on 10th April, 1932, with 20 lbs. rye grass collected from a persistent area in a corner of the farm. The rye was sown under cover of 1 bushel of Burt's Early oats.

Cultivation and History.—Peas and oats cut the previous year for silage. Discd in March in preparation for sowing. Pasture harrows used once during growth. This area of $1\frac{1}{2}$ acres had 207 cow-grazing days between May 25th and June 27th; from September 10th to December 30th—303 grazing days. In May, 1933, the rye grass plants, showing $7\frac{1}{2}$ per cent. cover, were vigorous and about 3 inches in height. The paddocks had a light fire over them during March and were tyne harrowed twice at the beginning of May. November, 1933, rye grass average height 2 ft. 3 inches to 2 ft. 6 inches, very even and carrying little subterranean clover. Topdressing was carried out with superphosphate and ammonia No. 3 at the rate of 150 lb. per acre.

A. Trigwell.

Soil.—Clay flat carrying flooded gum and blackbutt; red gum originally.

Mixture—Rye grass and subterranean clover with some trefoils and *paspalum* in patches.

Ground under pasture for eight years. Rye grass collected from old strain persisting in certain areas on the farm. Seed broadcasted before first rains. Topdressing—1 cwt. superphosphate in autumn and spring, May, 1933. Grazed continuously, pasture growing vigorously. November, 1933—Good mixture rye and subterranean clover. Rye not as even as that of Mr. B. Langridge. Estimated 10 tons per acre.

R. J. Trigwell.

Utilised an acre of gully land which was ploughed twice and was broken down with an iron rail and then disc harrowed.

Four lb. lucerne, 4 lb. perennial rye grass, and 3 lb. *phalaris tuberosa* were sown on 29th September, 1932.

At the date of the first inspection the plot was particularly promising, being still green and growing vigorously. The lucerne and perennial rye grass were very strong. The *phalaris tuberosa* was not plentiful but was healthy. The rye grass dried off during the summer, and the lucerne kept green. After the first rain on April 6th, all plants gave rapid growth, and in three weeks a 4-inch growth was grazed. When inspected on 23rd May, there was a 6-inch growth. In the other paddocks on the property there had been no feed until this time. Topdressing with one bag of superphosphate was carried out.

The final inspection was made in November. The rye grass was excellent and of an average height of 2 ft. 6 inches. *Phalaris tuberosa* was scattered but healthy, and the lucerne was going back on account of the attacks of lucerne flea which were particularly severe. A further topdressing with one bag of super. and ammonia No. 3 in August, and one bag of super. in September was

given. It was estimated that 75 per cent. of the weight was rye grass. Grazing had been continued throughout the winter, stock being withdrawn at the beginning of September. This continuous grazing probably had some effect on weakening the lucerne.

J. Hearman.

Entered one acre of old pasture of which at least one-half was carrying paspalum. The other growth was couch. Subterranean clover, silver grass, spear grass, ferns, and rushes were present on this area. Grazing was continuous throughout the year. The area was topdressed with 1 cwt. on superphosphate in spring and autumn. This paddock would benefit from strong cultivation.

J. G. Fry.

Entered one acre of old pasture which was different from that of Mr. Hearman in being on a hillside. This carried a mixture of paspalum, couch, subterranean clover and mixed annual grasses. A very dense stand of grass was evident during the spring.

THE SUMMER FEEDING OF SHEEP.

E. J. UNDERWOOD, Ph.D., B.Sc., Animal Nutrition Officer.

(Published by courtesy of the Australian Broadcasting Commission, being an educational talk given through Station 6WF on 23rd February.)

The recent phenomenal rise in wool prices has made the farmer turn his attention more and more to sheep as the revenue producers of the farm. Every farmer is now anxious to carry as many sheep on his property as he possibly can and to have them producing heavy, sound fleeces of good quality. To do this he must not be seriously overstocked at any time of the year with respect to the available resources of his farm. The carrying capacity of a farm depends less on the growth of feed in the flush period than on the number of sheep that can be carried over the dry summer and early autumn. For nearly half the year, on most West Australian farms, there is usually sufficient grazing to carry about two sheep to the acre, but for the other half of the year three acres to the sheep would often be rating the grazing too highly. It follows then that if we can increase the carrying capacity during these months of each year, the carrying capacity for the farm for the whole year is correspondingly improved.

It is obviously not possible to supply green nutritious grazing throughout our long dry summer, and the dried-out grasses and stubbles which are available represent a woefully deficient ration even for mature wethers and much more so for young growing sheep and breeding ewes. It is important to realise that this is a state of affairs which occurs not occasionally or for brief periods, but for six months in every year right throughout our agricultural areas. Our summer has been very aptly described as an "annual drought," and since we cannot prevent this drought, it is essential to try and overcome or at least minimise its effects, by making the good time of the year provide for the bad. This is best done by conserving fodder in various ways in the spring for hand feeding in the late summer and early autumn.

Periodically, in practically all the sheep districts of Australia, resort has to be had to hand feeding of some sort or another. In the agricultural areas of this State I am convinced it must become a regular part of farming practice.

In order to better understand the necessity for supplementing the summer grazing with suitable foodstuffs, some idea of the seasonal changes in the feeding value of pasture must be gained. The feeding value of young green pasture at the short leafy stage is extremely high and especially suitable for growing, breeding, and milking animals. It should be the aim of every farmer to produce as much of such pasture as possible by sowing the best plant species available and by top-dressing with superphosphate regularly in early autumn. This top-dressing with super will not only increase the quantity of herbage available but will also improve its quality by stimulating the growth of clovers. The practice of top-dressing pastures is by no means sufficiently frequent among sheep farmers in this State.

As the plant species comprising a pasture "get away," i.e., as they approach maturity, their feeding value falls. This is due to the fact that they become more fibrous, less digestible, and much lower in protein and phosphate. In other words, the pasture changes in character from a rich digestible concentrate in its young green stage to a fibrous roughage, low in protein and phosphate in its mature dry stage. This falling-off in feeding value proceeds very slowly until the drying off, or ripening stage is reached, when it proceeds very rapidly. Silage and hay should be cut at the flowering and "milk" stage respectively before this takes place, so as to insure a good quality fodder. There is a very sound reason for the preference for cereal chaff of a good green colour. Farmers should avoid the all too common tendency to let hay go just a little later before cutting. Although there may be a gain in **weight** of hay, by waiting there will be a loss in **quality** and in the total digestible food produced.

From November to May over most of the Southern portion of this State, there is no regular dependable rainfall, and in consequence no growth of pasture or of crops, except in small favoured situations. This means that the food supply of the grazing animal throughout the summer is being affected in two ways. First it is being reduced in **quantity** owing to the fact that it is being consumed all the time and no growth is being made to take its place, and second it is being reduced in **quality** owing to the fact that the animal grazes selectively, always eating the best feed first. This selective grazing is very well illustrated when sheep are turned into a stubble paddock. They quickly eat out all the grain, then the leaf or "flag" and the bottom growth is consumed and finally they are left with nothing but pure straw on which to try and eke out a precarious living. In consequence, by March and April, and even earlier, the average farm sheep is being half starved and the food that it does obtain is very poor in quality, being particularly deficient in protein and phosphoric acid. The object of hand feeding is to increase the quantity and improve the quality of feed available in as sound and economical manner as possible.

To increase the quantity of food available, a small regular ration of about $\frac{1}{2}$ lb. hay or 2 lbs. silage per sheep per day could be fed. Both these roughages are easily produced on the farm and are readily consumed when cut at the right time, and well made. Good silage is said to be rather easier to make than good hay and has the very great advantage in the summer of being succulent. Oats or wheat alone makes quite good silage for sheep, but oats and peas give an excellent product either in a tower, or in a pit where chaffing is unnecessary.

Silage has the one disadvantage of being very heavy to handle and in consequence somewhat expensive in labour. Nevertheless in some experiments at the Werribee Farm, Victoria, it was found to be considerably cheaper than hay as a means of keeping sheep in a thriving condition. Hay may be fed in racks or distributed in sheaves on the ground. Chaffing should not be necessary unless the price of hay is very high, as there is little waste with good quality long hay.

Such a method of feeding, if carried out right throughout the summer, should suffice to keep mature sheep thriving and free from gross deficiencies, particularly where a good phosphatic lick is available at the same time, but for weaners and for ewes just before and after lambing, a further food supplement is suggested to improve the quality of their ration. With weaners it is particularly necessary to start supplementary feeding early as this greatly minimises the effects of worm parasites. As has been pointed out, the two most serious deficiencies in our summer grazing are protein and phosphate. The necessity for phosphatic licks is becoming generally recognised owing to active propaganda on the part of this department. It is not realised however, that protein is equally necessary for the best returns under our late summer conditions. A small ration of oats, say $\frac{1}{2}$ lb. a day per sheep, will help in this regard and is within the means of most farmers. Better still from the point of view of supplying protein are peas, lupins, and linseed nuts of which $\frac{1}{4}$ lb. per sheep per day would represent a very good supplement. Experiments have recently been carried out in the Eastern States with the slaughterhouse products blood-meal and meat-meal. These two products are composed almost entirely of protein and mineral and as little as 6 ozs. per sheep per week as a supplement to dry grazing gave increased growth in young sheep and wool increases as high as 30 per cent. It seems reasonable to expect that under our late summer conditions a similar small supplement of blood-meal or meat-meal would make good the protein deficiency and give enhanced and payable wool increases. This problem is being investigated by the department at present.

In regard to the feeding of licks it cannot be too strongly emphasised that phosphate is the only mineral known to be required and complicated mixtures containing such things as iodine, sulphur and magnesia are wasteful, unnecessary and costly. The dicalcic lick as recommended by the Department of Agriculture is palatable, it is high in available phosphate, it contains no added superfluous minerals and above all it is very much cheaper per unit of phosphate than any other lick. It should be exhibited to sheep in boxes or troughs round the watering places from the time the feed dries off until the green feed comes again. If kept constantly before them, sheep will consume about 14-20 lbs. of lick per 100 sheep per week. There is some evidence accumulating, and the question is being tried out experimentally by the department at Meckering now, that where the lick is being consumed in adequate amounts, the incidence of the depraved appetite which impels sheep to consume rabbit carcasses, is greatly reduced. In this way it should be possible to greatly reduce the mortality from toxic paralysis which is due to the ingestion of a poison present in decomposed carcasses. If the food supplements suggested earlier are also being fed, the value of the lick is being greatly enhanced and the chances of the sheep showing depraved appetite and hence toxic paralysis are reduced to a minimum.

In conclusion it must be emphasised that it is not thought for one moment that the last word on the summer feeding of sheep has been said with the foregoing remarks. We are sadly in need of more information on the composition of our pastures and of more feeding experiments. Nevertheless it is confidently asserted that if the feeding principles laid down are adhered to, there will be

greatly lowered stock mortality, better lambings, less unthriftiness in weaners and increased wool returns per sheep. The points of greatest importance are—

1. Conservation of ample hay or silage, or both, for feeding in small amounts right throughout the summer for the whole flock.
2. Further supplementing with oats or better, peas, lupins, or linseed, for weaners and for mated ewes just before lambing.
3. Regular supplies of a good phosphatic lick for all sheep.
4. The provision of small amounts, about $\frac{1}{2}$ lb. per sheep per week, of meat-meal or blood-meal as a stimulant to wool growth, where other protein concentrates such as peas, lupins or linseed are not being fed.

WHEAT VARIETIES SOWN IN WESTERN AUSTRALIA.

R. P. ROBERTS, Agricultural Adviser.

The following table shows the acreages of the more important varieties of wheat sown in Western Australia for the seasons 1930-31 to 1933-34. The acreage figures, which were supplied by the Government Statistician, were obtained when the acreage forecasts were collected in August of each year.

Variety	SEASON.							
	1930-31.		1931-32.		1932-33.		1933-34.	
	Acreage. (000's)	Approximate Percentage of Total.	Acreage. (000's)	Approximate Percentage of Total.	Acreage. (000's)	Approximate Percentage of Total.	Acreage. (000's)	Approximate Percentage of Total.
Nabawa	1,724	41	1,100	33	983	28	626	18
Gluyas Early	662	16	566	17	594	17	556	16
Merredin	474	11	412	12	459	13	413	12
Federation	166	4	73	2	33	Less than 1.5	27	Less than 1.5
Yandilla King	136	3	92	3	64	2	28	"
Bena	133	3	114	3	151	4	141	4
Canberra	87	2	77	2	77	2	79	2
Ford	81	2	82	2	117	3	120	4
Clubhead	76	2	74	2	34	Less than 1.5	4	Less than 1.5
Gresley	74	2	64	2	43	"	42	"
Baroota Wonder	71	2	62	2	49	"	49	"
Gallipoli	62	Less than 1.5	80	2	79	2	85	3
Glueclub	58	"	133	4	334	9	307	9
Noongar	52	"	89	3	145	4	196	6
Georallying	49	"	51	2	69	2	91	3
Dollar	38	"	20	Less than 1.5	11	Less than 1.5	9	Less than 1.5
Waratah	25	"	44	"	103	3	179	5
Neneubbin ... ..	...	...	1	"	14	Less than 1.5	241	7
Other Varieties	242	6	186	6	185	5	186	6
Total	4,210	...	3,320	...	3,544	...	3,380	...

The most striking feature of the table is the rapid decline in acreage of the leading variety "Nabawa." Over the four-year period to which the figures refer it has dropped from 1,724,000 acres to 626,000, or from 41 per cent. of the total area to 18 per cent. Despite this it is still the most popular variety, but it appears likely to be displaced from this position in the near future.

The two early maturing varieties, "Gluyas Early" and "Merredin," have maintained their positions of second and third respectively. The percentage acreage of these two well known varieties varies but little from year to year.

"Federation" and "Yandilla King" have lost a considerable amount of their popularity, and now the acreage of each is down to less than 2 per cent. of the total.

The varieties "Noongar" and "Waratah" have both shown a considerable increase in acreage, the former on account of its suitability for planting in districts where early maturity is essential for success.

"Glueclub" increased very rapidly in the first three years of the period under review, but its rate of increase now appears to have ceased.

Probably the most spectacular advance has been made by the new midseason variety, "Bencubbin." Only one thousand acres were sown in 1931-32 and this had increased to 241,000 acres two years later. It is likely that next season this will be the most extensively grown variety in the State. It is a variety almost identical with "Nabawa" in morphological characteristics, but it has proved itself a better yielder.

The total acreage of "strong" or "premium" wheats amounted to 0.7 per cent. of the total in 1930-31, 0.8 per cent. in 1931-32, 1.0 per cent. in 1932-33, and 0.9 per cent. in 1933-34.

The accompanying table shows the percentages of late, midseason, and early varieties (areas of 5,000 acres and over) sown in the four years under review. It will be observed that there has been a gradual but definite movement from late to midseason varieties and again from midseason to early varieties.

Maturity.	SEASONS.			
	1930-31.	1931-32.	1932-33.	1933-34.
	Percentage of total.	Percentage of total.	Percentage of total.	Percentage of total.
Late varieties	7	5	4	3
Midseason varieties ...	60	57	56	56
Early varieties	33	38	40	41

RESUME OF INFORMATION REGARDING FEED FLAVOURS IN BUTTER.

Paper read at Conference of Dairy Factory Managers and Secretaries' Association, Perth, 1934.

G. K. BARON-HAY,
Superintendent of Dairying.

In suggesting the subject for my address as a resumé of our knowledge of food taints in butter, and their control, it was in the belief that the elimination of feed taints is the major problem facing manufacturers of butter in Western Australia to-day, and the seriousness of the problem has been accentuated since this State entered the export trade. The palate of the local consumer has become accustomed to the peculiar flavour of Western Australian butter, not at all unpleasant, and this peculiar flavour is not noticed until butters from other areas are tasted.

On the British market, however, this "feedy" flavour, as it is called, is undesirable because of its departure from the accustomed taste.

A survey of London reports on butter exported from this State shows that, except in a very few instances, our butters were degraded on account of this "feed flavour" though rarely penalised for manufacture, a typical London grading report being "strong feedy flavour—good body and texture, 89-90 points," a butter which, otherwise, would be choice.

It is estimated that these flavours depressed the average price of factory butters by at least 1d. per lb., which on the factory production for 1932-33 amounted to no less than £40,000, and it will be agreed that this is a most conservative estimate. This loss at the present price of butter fat is approximately 12 per cent. and equivalent to a loss of £14 per annum for each 20 cows milked, and thus constitutes a serious drain on the industry.

The whole subject of odours and flavours in milk, cream, butter and cheese is greatly complicated by the fact that there is a wide range in the ability of different individuals to detect and distinguish them. Flavours and odours plainly evident to one person are unnoticed by another. Undoubtedly also, in many instances, odours or flavours in cream charged to the feed or cow, are due to contamination of the product in the stall or elsewhere, after it is drawn from the cow.

The literature on the question of feed taints in dairy produce is very scanty, particularly as regards suggested means by which these feed flavours may be eliminated.

Feed flavours found in cream and subsequently in the butter manufactured therefrom may be classified under two main headings:—

- (a) Flavours absorbed from feeds after the milk has left the cow.
- (b) Flavours present in the milk when drawn from the cow.

This first class of feed flavours presents little difficulty.

Milk or cream should not be stored near such substances. Fodders referred to in this connection would be—onions, fish, apples, cheese, bacon, etc. These flavours also can be readily detected on the grading floor, and the farmer advised accordingly.

The second class, namely, the treatment of feed flavours already present in the milk when drawn from the cow, presents far greater problems.

It is on the elimination of these flavours that information is desired, and it is believed that finality can only be arrived at by tackling the problem locally, as methods of elimination as a result of investigations carried out in other areas or other countries with different pasture plants may not and, indeed, have not proved successful in this State.

It is generally recognised that such plants as rape, cabbages, turnips, wild garlic, swedes, etc., will give a feed taint to milk and cream, and experience has shown locally that subterranean clover pasture will give a decided feed taint to milk and cream, and thus to butter. Recent observations, however, have cast strong suspicion on a number of indigenous plants occurring in the high rainfall areas, such as *Opercularia* sp., Penny Royal (*Mentha Pulegium*), Jam tree (*Acacia acuminata*), Batchelor's Button (*Cotula coronopifolia*) which when eaten by cows impart a decidedly unpleasant flavour to milk and cream. Unfortunately, it has been inferred generally that these flavours are due to volatile and aromatic chemical compounds, and that being volatile they may be removed by various mechanical devices designed, generally, to cause steaming which will remove these volatile substances. A study of the available facts shows that this is far from being the case.

In an investigation by Roadhouse and Koestler into the constituents of milk affecting its "taste," in 1929, some interesting facts regarding feed flavours were noticed.

If clean milk be placed in a collodion filter and then hung in distilled water which is flowing constantly, it was found that after 15 hours the residue in the container was composed mostly of the fat and milk proteins, while the sugar and soluble salts had passed from the container into the distilled water.

It was found that the residue was tasteless and that the taste of the milk was due to the substances that had passed through the collodion filters.

The fat and casein of clean milk impart practically nothing to the taste, contrary to popular opinion. This taste, for convenience, may be called the "primary" or "foundation" taste of milk.

When milk with a decided feed or "secondary" taint was subjected to the same treatment, it was shown that the feed taste was found very largely in the residue, and as it did not pass through the filter was thought to be either combined with the protein or dissolved in the butter fat.

If the former supposition is the correct one, then such flavours can be almost eliminated by careful churning and washing so as to reduce the curd content of the butter to a minimum.

If the flavour is dissolved in the butter fat, elimination may not be easy and may be impracticable under present day factory conditions, as it is extremely difficult to remove dissolved flavours from fats.

Indeed, the power of fats to dissolve essences is used by perfume manufacturers in Europe to remove the desirable aromas from flowers. In the "Enfleurage Process" for extracting perfumes, a thin layer of the flowers is laid on a layer of fat (animal) and kept at a warm temperature, the fat absorbing the perfume. The fat is then treated with petroleum ether in order to remove the perfume but always retains sufficient of the aroma to be sold as a pomade.

It thus will be realised how difficult the removal of such dissolved feed flavours would be in a factory.

Another means by which flavours classed as "feed taints" may gain access to dairy produce has been indicated by Oria Jensen, of Copenhagen, Weigmann and others. These investigators have pointed out that, when certain fodders are eaten containing pungent principles, these may pass into the milk through the udder but do not impart a disagreeable flavour until broken down by certain groups of bacteria. In some cases it has been possible to isolate bacteria giving a turnip flavour to milk, and in another a carrot flavour, without these substances having been fed to the cow.

It also was shown that the groups of bacteria effecting these changes belong to the "coli" and "putrefactive" groups which liquefy nutrient agar media.

From the foregoing it thus will be seen that flavours derived from the cow may be sub-divided into three classes:—

- (a) Flavours produced by aromatic volatile compounds.
- (b) Flavours due to compounds which are aromatic and are dissolved in butter fat.
- (c) Flavours due to contamination with certain bacteria, which break down compounds present in the milk, producing food flavours.
- (d) Dealing with the first class, it has been shown that these may be almost eliminated by the combined action of the farmer and the factory manager.

Aeration and cooling on the farm over any approved water cooler removes a considerable proportion of these flavours; the work, however, must be completed at the factory.

Neutralisation of the cream while between 90-100 deg. F. is found to be of great assistance and is stated by certain authorities to be more efficacious than the pasteurisation at flash temperatures of 185 deg. F. to 190 deg. F., owing to the very short exposure at these high temperatures. and this opinion is borne out by results in this State.

Heating of cream under vacuum, as is carried out in so-called deodorisers, has given good results in New Zealand and New South Wales. London grade returns so far to hand for butter manufactured with a deodoriser in Western Australia show that there is less feed taint on arrival in London, and the butter has held up to grade reasonably well.

Further information is required, however, before any definite recommendation can be made for this State, though it is reasonable to believe that this class of flavours can be efficiently eliminated.

Class (b)—those dissolved in butter fat present very serious difficulties. It is impossible at this stage to state whether this type of flavour is affecting our butter. What evidence is available, however, points to the probability that the position is not serious. Throughout the flush season, the London gradings of butter showed that certain factories were able to manufacture butter which held its grade, and receive a comment of only "slight feed taint." None of these factories, however, were consistently good, indicating that the elimination or reduction of the feed flavour was due to some factory process.

If the fodder flavours—and in this case the dominant flavour undoubtedly would be "clover taint"—had been dissolved in the fat, butters would have been consistently graded "high clover taint." Here also pasteurisation would have little effect in reducing these flavours.

The third class (c), where feed taint is associated with bacterial contamination, is more easily controlled than flavour falling in the previous class (b).

What evidence is available points to these series of taints being the dominant cause of deterioration in export butters in Western Australia.

It is a significant fact that in the second year of export, London gradings called this flavour "cowy," later changing the description to "clover" or "strong feed taint" after the Senior Commonwealth Grader (Mr. F. Wigan) had visited this State.

There is also the fact that in those butters so graded, it is known that this flavour becomes intensified. This is in keeping with an association of bacterial origin even though development may be very slow at cool storage temperatures. Slight feed flavours due to volatile substances, on the other hand, tend to decrease with storage.

There is also the fact that butters from areas devoid of subterranean clover have been found to hold to their grade reasonably well under export conditions.

It is known that in one factory, where a special effort was made for two weeks during October, butter of up to choice quality was exported, and the consignments held up to grade well, feed taint being very slight.

In view of the above, it is suggested that the "feed taints" in our butters during the flush months may be due to contamination of cream with "liquefying" or "coli" bacteria, which break down a basic substance obtained from ingested subterranean clover. Conn, Orla Jensen, Esten, Wolff, and others have

shown that at temperatures not far below 41 deg. F. the growth of this type of liquefying bacteria is not inhibited, and this is the usual holding temperature of cream prior to churning.

Should this theory prove correct, elimination of feed flavours will not depend on particular machinery but on careful attention to cleanliness from farm to factory, and during the manufacturing processes. It will be essential for pasteurisation also to be carried out efficiently.

The question of correct grading now assumes greater importance than ever (if that were possible), as only by elimination of all creams carrying undesirable bacterial taints can there be some degree of certainty of preventing these flavours from being produced.

The important question of elimination of feed taints, however, in Western Australia can only be solved by original research work being carried out in this State.

The nature of the investigation will call for close team work between factory managers, the Field Staff of the Dairy Branch, the Government Botanist and the Technical Staff of the Laboratories of the Department of Agriculture. It is hoped that it will be possible to undertake some of the work this coming season.

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NOTES ON THE DARTMOOR AGRICULTURAL AREA.

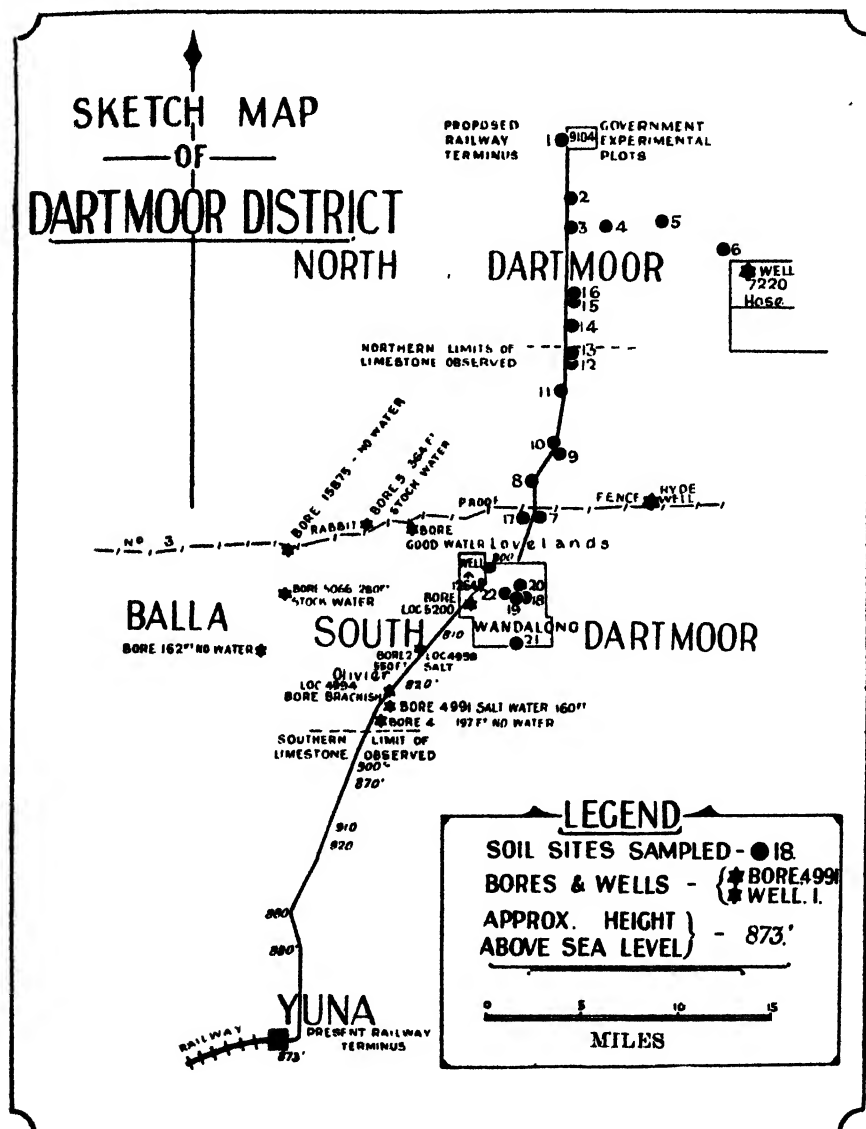
By E. S. Simpson and L. J. H. Teakle.

GENERAL AND HISTORICAL.

Dartmoor is an agricultural district in the early stages of development, lying about 75 miles to the north-east of Geraldton and centering about Lat. 27deg. 50 min. S. and Long. 110deg. 10min. E. The subdivided area, stretching southward from the Murchison River, is 35 miles in length from north to south, and 12 miles in width. The southernmost quarter of the area, conveniently referred to as South Dartmoor, is separated from the northern portion, North Dartmoor, by the No. 3 Rabbit-proof Fence, which runs east and west.

Before subdivision, a large part of the area had been used for sheep grazing under pastoral lease. As far back, however, as 1911 about twenty 1,000-acre agricultural blocks had been surveyed in South Dartmoor, and others again in

1920-1. A number of them were occupied by R. Olivier, the Wandalong Syndicate, and others; R. Olivier growing the first crop of wheat in the district in 1920, and the Wandalong Syndicate having a small area (220 acres) under crop in the following year.



In 1929, Surveyors Brookway and Nunn surveyed and classified the remainder of the area, cutting it up into 201 further blocks ranging from 1,000 to 2,600 acres in area. In addition, 41 blocks were surveyed down the south bank of the Murchison River to the west of Dartmoor.

Towards the end of 1929, none of the most recently surveyed blocks having been occupied, the Wandalong Syndicate offered to assist the Government in preparing and managing an experimental plot in North Dartmoor to determine its

possibilities in regard to wheat growing, and an area of 100 acres in the south-west corner of Location 9104, twenty miles north of the rabbit-proof fence, was chosen by the Surveyor-General for this purpose. A road was cut through dense bush to this block by October, 1930, and by the same time the native vegetation (large cypress, mallee, carara, etc.) on the plot was cut down, but not burnt off till the following January. In May, 1931, one-half of the area was sown for the first time with wheat of three varieties, and with one variety of oats. A second series of experimental plots were grown on the same area for the Government in 1932.

The total area subdivided in the district measures 378,000 acres, classified as follows:—

	First Class.	Second Class.	Third Class.
Acres	205,000	125,000	48,000
By the end of 1931 the area of land selected was—			
	First Class.	Second Class.	Third Class.
Acres	27,500	22,650	12,750
Total—62,900 acres.			

Altogether there were 4,750 acres under cultivation by thirteen different land-holders in the 1932 season.

COMMUNICATIONS.

The Government railway now reaches from the deep sea port of Geraldton to Yuna, a distance of 46 miles. From here a single well-ballasted road stretches to the south end of the Dartmoor area, and continues as a cleared track, with short stretches of ballast, northwards through the centre of it as far as the Government experimental block (Location 9104). Distances from Yuna are:—

To north end of Yuna holdings	10 miles.
To south end of Dartmoor holdings	18 miles.
To Wandalong homestead	28 miles.
To No. 3 Rabbit-proof Fence	32 miles.
To Government Experimental Block 9104	52 miles.

From the Rabbit-proof Fence crossing at 32 miles a branch road leads off to the east and north-east following up the boundary between the North Dartmoor blocks and Hoses grazing blocks 7220, etc. This road is only ballasted over a few short lengths.

The Railway Advisory Board visited the district in 1932, and a railway survey is now being made approximately along the route of the main road as far north as the Government experimental block. No serious difficulty should be experienced in locating an inexpensive route for it.

TOPOGRAPHY AND GEOLOGY.

Leaving Geraldton one passes up the gentle incline of the Chapman Valley towards Yuna with Precambrian gneiss, traversed by dolerite dykes, occupying the wide bed of the valley. The ridges on either side, which are about 500 feet high at the mouth of the valley, are capped by horizontal sediments forming a gently rising plateau, on to which the Chapman railway emerges a little to the south-west of Yuna. From Yuna right through to the Murchison River there

stretches an undissected plateau of sedimentary material, which A. Gibb Maitland*, according to his geological map of 1920, considered to be of Jurassic Age. The plateau has an average elevation of 800 to 900 feet above sea level and extends westward to the ocean between the Hutt and Murchison Rivers. It is only dissected by the valleys of those two rivers.

T. Blatchford† suggests in a report dated 1927 that the underlying formation at Dartmoor may consist of sediments of Carboniferous Age forming a northward continuation of beds of that Age occurring at Eradu on the Geraldton-Mullewa line. The present writers observed Cretaceous chalk and greensand overlying what are probably Jurassic sandstones at the lower end of the Murchison gorge for at least ten miles in from the sea, but were not able to collect any evidences of age in or near Dartmoor.

The only rock outcrops in the Dartmoor district are very small and very scattered, the whole area being thickly covered with sandy or loamy soil. The few bores, wells, pits and surface outcrops which have been examined indicate, however, a total absence of granite, greenstone, or metamorphic schist. In every case, whatever their age, the underlying rocks have proved to be sandstones, shales, and conglomerates, together with a lime carbonate series, which includes dolomite, limestone and both nodular concretionary, and powdery incoherent, calcite.

The lime series is particularly interesting, and must have some bearing upon the fertility of the district. Low domes of hard white, often brecciated, limestone are scattered at intervals over the area between Location 9201 (10 miles north of the rabbit-proof fence) and Olivier's block (4996) on the southern boundary of the Balla and Dartmoor groups. These rise to a height of at most five feet above the prevailing soil, and are associated with the better class country. An analysis of a very dense cream coloured "limestone" on Location 5194 showed it to be a practically pure dolomite. Three other outcrops were more normal limestones (see Appendix 1.) The approximate compositions of the four were:--

Site, Block No.	5194	5194	9211	9212
	S. end	N. end.	E. side.	S. end.
Calcium carbonate	50.9	71.8	64.3	74.2
Magnesium carbonate ..	40.0	18.4	13.2	9.3

Portions of the limestone outcrops are grey in colour, as though affected by bush fires, and when freshly broken exhale a distinct odour reminiscent of hydrogen phosphide and sulphide. Tests of several pieces for bitumen and phosphorus revealed, however, none of the former and only the usual traces of the latter. The odour is evidently due to pyrolysis of organic matter by scrub fires. In other places, where no hard limestone showed at the surface, powdery or concretionary calcium carbonate was found in more or less abundance in the subsoil, particularly on the north boundary of Block 5199, close to the Wandalong Syndicate's experimental plots. Particulars of this will be found in Appendix IV., Table IV.

The surface of the better country is almost perfectly flat, but the poorest sandy and scrubby country has developed, under wind action, loose sand ridges rising to 50 feet above the average level. These are particularly noticeable to the south-west of the Dartmoor area, but smaller ones are occasionally seen in the heart of the subdivided tract, for example, in the vicinity of Locations 5212 and 9204.

Only a few very small clay pans were noted in the subdivided area, but beyond the east side of it, typical Murchison mulga country begins, and there are some well marked salinas or salt marshes (Narramine "Lakes").

* Then Government Geologist.

† Present Government Geologist.

Water courses of any kind are absent except for the mature bed of the Murchison River, which forms the northern boundary of the area.

CLIMATE.

Dartmoor lies in latitude 28deg. South, 70 miles from the Indian Ocean (without any intervening range), at an average elevation of 900 feet above sea level, between the 10 and 12½-inch isohyets, and within the region of winter rainfall. These are the main factors governing the climate.

The nearest point for which average temperatures are available is Chapman State Farm, which is about 60 miles from the centre of Dartmoor. The records for Chapman are:—

	Jan.	Feb.	Mar.	April.	May	June.
Maximum (average) ..	92	93	89	83	73	67
Minimum (average) ..	63	65	61	58	51	48
	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum (average) ..	66	67	71	75	84	89
Minimum (average) ..	46	46	48	50	56	60

Mean annual—Maximum (average) 79; minimum (average) 54.

The Commonwealth Meteorological Bureau considers that Dartmoor temperatures would probably be very close to these figures.

Occasional frosts have been experienced at midwinter at South Dartmoor, but there are never any spring frosts which would imperil the fertilisation of the wheat.

Rainfall records are available for Wandalong Estate (Location 5190) and Yallalong Homestead on the Murchison River 30 miles to the north-north-east of the centre of Dartmoor. For two years (1931-2) records were also taken at the Government block 9104 (North Dartmoor) during the wheat-growing period (April to October).

The Wandalong returns in points (100 = 1 inch) for the past seven years are:—

	Jan.-March.	April-June.	July-Sept.	Oct.-Dec.	Total.
1927	623	376	409	87	1,495
1928	263	424	309	81	1,077
1929	381	472	143	49	1,045
1930	94	553	296	66	1,009
1931	12	376	429	118	935
1932	303	432	507	210	1,452
1933	150	331	428	125	1,034
Averages ..	261	423	360	105	1,149

On the Government block, 24 miles further north, the figures were:—

	Jan.-March.	April-June.	July-Sept.	Oct.-Dec.	Total.
1931	21	598	329	105*	1,053
1932	12	376	344†	—	—

The average annual fall for Yallalong over a period of 26 years has been 1,043 points, the lowest record being 351 in 1911, and the highest 2,073 in 1915.

For all three stations it would appear that about two-thirds of the total fall occurs in the winter months during the wheat growing period; that most of the

* December not recorded, estimated at 20 points.

† July and August only, September to December not recorded.

rest of the rain is derived from thunderstorms during January, February and March; whilst the last three months of the year are usually very dry. The above records show that during the growing period for wheat Wandalong has received from 615 to 939 points with an average of 783 points.

Owing to the comparative proximity to the coast, dews are noticeable during a large part of the year. Whilst these may assist to some extent in the growth of wheat, they are likely to interfere with harvesting, and to yield a wheat of lower quality than that produced in an area of consistently drier atmosphere, *e.g.*, Merredin.

On such an unbroken plateau of loose and comparatively fine grained soil, wind action must be seriously considered. Where the poorest soil has only developed a scanty growth of low scrub, wind action has plainly been at work piling up sand ridges 20 to 50 feet high. In the better class land, with a fairly dense protecting cover of forest and tall undergrowth, this action has not been apparent in the natural undisturbed state. The Wandalong Syndicate, however, recognising the danger of extensive clearing, has wisely decided to leave 2-chain wind-breaks of original vegetation round each 150-acre plot of cultivated land. Even in these small areas very pronounced movement of the surface was observed on one day of our visit, dense clouds of fine soil blowing across a fallow field with every strong gust of wind. Much of the lifted soil appeared to be deposited in the first wind-break, where there were drifts already over a foot in thickness in places. The finest soil particles, however, for the most part were found to have escaped this local precipitation. Analytical details of the drift material from these small deposits at Wandalong, and from a large sand ridge a little to the south-west of Dartmoor, are given in Appendix II.

It is essential that any settlers on this area be warned of the extreme danger to themselves and their neighbours of clearing the country indiscriminately without allowing adequate wind-breaks at least every half mile in each direction.

WATER SUPPLY.

This matter was the subject of a report by the Government Geologist (Mr. T. Blatchford) in 1927* and additional information was gathered by us in 1932.

There does not appear to be any surface water on any part of the area, except for short periods after heavy rain. Nor are there any creek or river beds, except that of the Murchison on the northern boundary, in which permanent or seasonal pools can form. A few scattered claypans will doubtless hold temporary supplies after rain.

Most of the soils and subsoils examined are too porous and absorbent to permit of dependable dams being excavated except in some exceptionally favourable spots. Two such places are reported by the Wandalong Syndicate on their blocks 5203 and 5205. Settlers will therefore have to depend mainly upon rain water tanks, and wells or bores.

So far as rain catchments are concerned the Government has two large galvanised iron ones on the adjacent Balla area, and until recently had a third on Reserve 12648 at South Dartmoor. This last, however, was taken down and removed in 1932. Settlers' own corrugated iron roofs may be estimated to collect about 600 gallons for every 100 square feet of area with the known average rainfall of 11.5 inches.

* Annual Report of the Geological Survey for 1927, pp. 5-17, and Plate I.

The few shallow wells which have been sunk to reach the ground water level have done so at various depths, and with varying degrees of success as regards quantity and quality of supply.

One of the shallowest wells is on Hoses block 7220, in "mulga" country, just east of the subdivided area of North Dartmoor, where water was struck at 16 feet. Although strongly brackish (256 grains of soluble salts per gallon), it is being used for all domestic purposes by the owner. A complete analysis is in Appendix III. It is obviously not suitable for human drinking, laundering, or irrigation, but is an excellent stock water.

Excellent drinking water has been obtained at 13 feet in a well on Reserve 17940 on the north side of the rabbit-proof fence, details of which are:—

Reserve 17940, Hyde Well (Government): Depth 49 ft. Water level, 13 ft. Yield, not recorded. Total soluble salts, 51 grains per gallon, of which about one-half is common salt, the balance mainly sulphates. An excellent water for all domestic uses and for irrigation.

Further west along the rabbit-proof fence, 7 miles west of the Dartmoor boundary, a bore struck water at 364 feet. The yield was 8,000 gallons a day, and soluble salt content 195 grains per gallon, which is excellent for stock watering, but too saline for regular human consumption or irrigation. No more information is available regarding water supplies north of the rabbit-proof fence, and we are of opinion that further boring should be done in this area.

In South Dartmoor a number of Government and private bores have been sunk. In order of quality of water obtained, they are as follow:—

Reserve 12648, Government Bore: Depth, 250 ft. Yield, 12,000 gallons a day. Total soluble salts, 82 grains per gallon. Complete analysis in Appendix III. This is a good water for domestic use. Bore furnished with pump and tank.

Location 4995, Private Bore: Depth, 240 ft. (Water level, 200 ft.) Yield, not recorded. Total soluble salts 271 grains per gallon. Complete analysis in Appendix III. A good stock water, but too brackish for any domestic purpose.

Location 5200, Private Bore: Depth, 300 ft. (Water level, 221 ft.) Supply, not recorded. Total soluble salts, 921 grains per gallon; magnesia, 43 grains per gallon. This is a poor stock water, only suitable for sheep.

Reserve 13152 (Location 4992), Government Bore: Depth, 160 ft. Water salt.

Location 4999, Government Bore: Depth, 550 ft. Salt water at 225 ft., and nothing below.

Just south of Location 4991, Government Bore No. 4: Depth, 197 ft. No water.

Location 5070, eight miles west of Location 4999, Government Bore: Depth, 162 ft. No water.

Yuna road, four miles south-south-west of Location 4991, Government Bore: Depth, 202 ft. No water.

The Government Geologist's report of 1927 suggested the possibility of obtaining artesian water in the local sediments, but the only deep bore put down to 550 ft. in the south corner of Location 4999, after passing through salt ground water at 225 ft., failed to strike artesian water below. The complete absence of artesian water in the district cannot, however, be inferred from the failure of a single bore-hole only 550 ft. deep.

SOILS.

The soils reflect the climatic conditions and belong to the "Mallee Zone" types, but are distinct from the soils in any other part of the wheat belt of the State (except the adjacent Yuna and Balla areas) as a result of their derivation from geologically different material, viz., horizontally bedded marine sediments, whilst the main wheat belt soils are derived almost wholly from granite and associated greenstone dykes.

They were tentatively classified by the surveyors into first, second and third class. These were originally defined as:—

First class: Red sandy loam with dwarf York gum and yorrell south of the rabbit-proof fence, and tall cypress-pine (*Callitris glauca*) and occasional gums (eucalypts) north of it.

Second class: Red or yellow sand carrying Bowgada bush, carara and hard scrub.

Third class: Yellow sand dunes and sandy flats with low scrub and spinifex grass.

The total area of these three classes are recorded as:—

First Class	205,000 acres.
Second Class	125,000 acres.
Third Class	48,000 acres.

The third class land which lies just beyond the borders of the subdivided area in several directions is, of course, not included in these figures.

The soils of a number of typical areas were recently examined both in the field and in the laboratory, and as a result one of us (L.J.H.T.) has more closely defined five main groups of soil types as follow. Of them, those numbered 1A to E are subdivisions of the first class group of the surveyor's classification. Those numbered 2A and B are in the second class, and those numbered 3A and B in the third class.

(1) *Eucalyptus Forest* in the southern section.

Types 1A, 1B, 1C.—Fine grained reddish-brown sands to clay loams, generally of considerable depth and excellent water absorbing and holding capacity. Yorrell (*Euc. gracillius*), blackbutt (*E. oleosa*), York gum (*E. foecunda*), mallee, jam (*Acacia acuminata*), carara (*A. genistoides*), other wattles (*Acacia spp.*) and "wild olive" (*Bursaria spinosa*) appear to be the chief elements of the vegetation. Saltbush grows with York gum on the heavy flats in small depressions. The bulk of the present cultivation is on these soils, excluding the heavy York gum flats.

(2) *Cypress-pine Forest* in the northern section.

Types 1D and 1E.—The soils vary from shallow sands on a hard pan (usually siliceous) at about 20 inches in the depressions, to deep sands and loamy sands on rises. Large cypress pine (*Callitris glauca*) with Bowgada bush (*Acacia linophylla*), carara, scattered mallees and other shrubs are the chief elements of the vegetation.

(3) *Broom Bush and Mallee Country*.

Types 2A and 2B.—Mainly brownish sands with no tall vegetation, but characterised by the abundance of broom bush (*Melaleuca uncinata*), tea-tree (*Melaleuca spp.*), Bowgada bush, and mallee (low eucalypts). A hard pan occurs at about 20 inches in broom bush country (type 2A).

(4) *Yellow Brown Sands with Heath.*

Type 3A.—These are deep loose soils with laterite pebbles only at considerable depth (9 ft. on Location 9204).

(5) *Gravelly Sands with Wodjil and Heath.*

Type 3B.—Yellow sands with laterite gravel at surface increasing rapidly in amount with depth. Vegetation chiefly wodjil (stunted *Acacia* spp.) and heath.

Soil samples were taken from 22 sites selected to represent the major soil types of the district. Details of their examination, which are given in Appendix IV., suggest the following conclusions:—

The principal soils are of a sandy nature, which extends to the subsoils. Of the whole series, the York gum soils of type 1C are the heaviest, and the sandy heath soils (types 3A and B) the sandiest. The highest percentage of clay observed in a surface soil was 18 per cent. in a red loam from Location 9201. In the same hole the subsoil reached a maximum clay content of 26 per cent. at a depth of 12 to 19 inches, below which the clay fraction diminished again. Soils of the 3A type all contained over 90 per cent. of coarse and fine sand. Several of the better soils of types 1A, 2A and 2B carried no less than 87 to 90 per cent. See Appendix IV.

This sandy texture is a distinct advantage under the low rainfall, as the moisture is more available to the plant. Further, the texture of the soils is of such a nature that moisture is absorbed very readily, penetration is extensive and re-evaporation slow. The subsoil was observed to be moist at certain sites in November up to depths of 7 to 9 feet even in uncleared country. At another site in fallow, moisture was again observed to a depth of seven feet. Wheat roots would undoubtedly penetrate to this depth in such free soil, and make use of the stored moisture, which is equivalent to five to eight inches of rain. It is locally maintained that, because of this deep storage of moisture, September and October rains are not essential to the development of heavy yields of grain.

In regard to the physical constitution of the soils Table II. of Appendix IV. is of particular interest in that it shows the relative proportions of the different sized grains in the sand fractions. Certain significant ratios, calculated from this table and the preceding one, are set out in Table III.

It is noteworthy that the "coarse sand" fraction (2 mm. to 0.2 mm. diameter) exceeds the "fine sand" fraction (0.2 to 0.02 mm.) in every instance, the average ratio in the 47 samples analysed being 2.02, with a range of 1.02 to 4.13. Within the standard "coarse sand" group, however, by far the most abundant fraction is one of the finer ones, viz., that which passes a 30-mesh sieve, but is retained on a 60-mesh (0.42 to 0.21 mm.). This fraction averages 41.8 per cent. of the whole sand in the 47 soils. The next most abundant fraction is the finest of all, viz., that which passes a 120-mesh sieve (0.11 to 0.02 mm.).

These data from Dartmoor are compared in the table with those from Wongan Hills light lands, the soils from which resemble type 3 in many respects. The only notable difference is the lower proportion of the —30 +60 fraction in the latter, the deficiency being made up by an increase in the coarsest fractions. These resemblances suggest an ultimately similar origin for the two soils, probably in the disintegration of a fine grained granite, though the Dartmoor sands have undoubtedly passed through an intermediate phase of sedimentation, for which in the case of the Wongan Hills soils there is no evidence.

Samples taken from the sand drifts (see Appendix II.) differ only in the practical absence of the coarsest sand, retained on a 30-mesh sieve, and in having a somewhat larger proportion of the finer material passing a 60-mesh sieve.

A hard pan at shallow depths (20 inches or so) in certain soil types will probably limit moisture absorption in fallow, and will render these types less safe for wheatgrowing than the deeper soils. Fortunately our observations indicated that the more favourable, deeper soils predominate.

Owing to their loose friable nature the surface soils are liable to deflation, which will have to be guarded against by wind-breaks and the provision of proper tilth.

From a chemical standpoint the soils would not be classed as rich in natural plant foods according to European and American standards. They appear, however, to be normal for the Western Australian wheat belt, taking the soils on the Merredin and Chapman experimental farms as standards. Detailed figures are given in Appendix IV.

The nitrogen content is low in common with that of most soils of our drier areas. It appears, however, to be readily available, judging from the crop growth observed, and by comparison with experience at Merredin.

Phosphorus is low, but this deficiency is readily and successfully remedied on the land now cultivated by the addition of superphosphate at the rate of 70 to 90 lbs. per acre. More would be advisable on the third class soils, should any attempt be made to crop them.

Potash is normal in the eucalyptus forest and cypress pine soils, but is definitely low in the scrub and heath soils. The use of potash fertilisers, however, could not be recommended for cereal crops, without proof of their economic efficiency on trial plots, as experiments with cereals in other parts of the wheat belt have shown little or no response to the application of potash fertilisers.

Lime is plentiful in the eucalyptus forest soils, particularly in the subsoils, which are generally notably calcareous (see Appendix IV.). The cypress pine country is normal with respect to lime in the surface layers, but unfortunately shows no accumulation of calcium carbonate in the subsoil. The heath and wodjil country is very low in lime. Any lack of lime as a plant food would, however, be corrected by the use of superphosphate, which is necessary to counteract phosphorus deficiency.

The salt content of the soils is generally low, and observations indicate that there will be no appreciable salt problem to interfere with the development of the district. In view, however, of the experience elsewhere in the State, it is probable that, following clearing, some salt accumulation will be noticed in the heavier depressions and incipient lakes or salinas, which fortunately form only a small proportion of the total cultivable area.

The results of tests for salinity are given in detail in Appendix IV. Summarised they are, for top-soils:—

	Min.	Max.	Average.
Sodium chloride, per cent. . .	0.003	0.036	0.010
Water soluble salts, per cent.	0.019	0.087	0.044

These figures exclude an isolated record of 0.75 per cent. of salt in a clay pan. The highest percentages recorded in the subsoils of cultivable land to a depth of nine feet were:—

Sodium chloride, per cent.	0.153
Water soluble salts, per cent	0.281

As regards reaction, the cypress-pine soils, the scrub soils (second class), and the pure sands and gravelly sands of the heath and wodjil country (third class) are all acidic. This is not a serious matter *per se*, but probably indicates a lower level of fertility than that of the eucalyptus forest soils.

Summarising the soil conditions from the viewpoint of cereal growing, one may state:—

- (1) The eucalyptus forest soils are generally first class with respect to wheat-growing and mixed farming.
- (2) The cypress-pine country is similar in fertility to the Bowgada bush country, and is to be regarded as a superior second class. In certain restricted areas, which are as yet indefinable, hard pans will reduce the productivity.
- (3) The heath and wodjil country is inferior texturally and is generally of lower fertility than either of the above. Chemical differences are less striking than physical.
- (4) There is no appreciable salt problem at Dartmoor.

CROPS.

The area under crop in this district in 1932 was 4,650 acres.

The system of cropping at present adopted by one of the largest growers is as follows. All stubble is burnt off at the end of the summer. The land is not disturbed until June or July, when it is ploughed, and subsequently receives no treatment till it is sown with wheat in the following late April or May with a disc drill. In alternate years each field is cropped or fallowed. On one field lupins have been grown in place of fallowing. Harvesting begins about the first week in November. The sowing is done with 40 to 50 lbs. of seed wheat and 75 to 90 lbs. of superphosphate to the acre. Fallowed land has been giving about double the yield of new or unfallowed land.

Throughout the district fallowing is essential to the production of high yields, and cultivation of the fallowed land will become necessary as weeds are introduced. It is probable that the best farming methods practiced in the eastern wheat belt with respect to cultivation, seeding and manuring will be suitable for the Dartmoor area. The introduction of stock will be necessary for keeping down weeds, building up the lighter soil types, and maintaining soil fertility.

A large number of varieties of wheat have been experimented with, including:

Bencubbin	Merredin
Canberra	Nabawa
Centenary	Noongaar
Geeralying	S.H.J.
Gluelub	Totadgin
Gluyas Early	Waratah
Gresley	

Of these it is generally considered that Merredin has proved to be most suitable for the district. One plot of this variety at Wandalong in 1931 yielded 30.7 bushels to the acre.

Reporting on the milling quality of the different wheats grown on the Government block in 1931 the Director of Agriculture considered "S.H.J." to be the best, with Bencubbin, Nabawa, Noongaar and Geeralying also of very fine quality. The Merredin in this case was somewhat pinched.

Samples were obtained of a number of the wheats grown in 1932 both at Wandalong and the Government plots on Location 9104. The moisture and protein were determined in all of these and the results are given in Appendix V., Table 1. Five of them were selected for more detailed investigation by the latest methods, including milling, analysis of flour, and determination of both quantity and quality of the protein. The figures obtained are tabulated in Appendix V., Table II. In regard to Glueclub, a wheat whose quality has been widely discussed in recent years, the figures for the Wandalong sample show a high content of protein of poor quality, resulting in a poor absorption figure, also an objectionably low maltose figure. In general it is below F.A.Q. standard. The quality of the Ben-cubbin and Merredin wheats grown both at Wandalong and the Government plots are well up to standards for those varieties, and superior in quality to the same wheats grown at the Chapman State Farm.

Consistently high yields of grain have been obtained from all the farms in the Dartmoor and adjacent Balla districts since fallowing has been a regular element of farm management as the following figures show:—

Yield of Wheat in Bushels per acre.

Wandalong Estate.		
	Non-fallow.	Fallow.
1928 ..	13.6	—
1929 ..	*13.1	—
1930 ..	13.2	27.25
1931 ..	—	26.1
1932 ..	—	†25.6
1933 ..	12.5	23.1

* Merredin gave the heaviest yield, averaging 17.2 bushels.

† 3 per cent. of area was new land just cleared.

Yield of Wheat in Bushels per acre.

Government Block 9104.

	Non-fallow.	Fallow.
1931 ..	19.3	—
1932 ..	—	*20.8

* Appreciable loss through attack by galahs (*Kakatoe roseicapilla*).

District Averages.

	Area (acres).	Yield (bushels).
1930 ..	4,739	15.8
1931 ..	3,450	18.4
1932 ..	4,534	*18.6

* One farm which planted only fallowed land obtained an average of 25.6 bushels from 795 acres.

APPENDIX I.

ANALYSES OF LIMESTONES, DARTMOOR.

No. ...	...	5280.	5553.	5554.	5555.
		Dense dolomite Loc. 5194, South end.	Limestone R.P.F., near Loc. 5194.	Limestone Road, 4m. North of R.P.F.	Limestone Road, 3½m. North of R.P.F.
SiO ₂ ...	...	6.24	7.27	18.96	13.14
Al ₂ O ₃ ...	...	.52	1.73	.75	2.48
Fe ₂ O ₃ ...	...	.33	...	...	...
FeO ...	...	.08	...	...	...
MnO ...	...	nil	...	...	...
MgO ...	...	19.63	8.78	6.33	4.44
CaO ...	...	28.66	40.21	36.02	41.56
Na ₂ O ...	...	.07	...	...	...
K ₂ O ...	...	.09	...	...	...
H ₂ O +	...	.56	...	...	...
H ₂ O -	...	.57	...	...	...
CO ₂ ...	...	43.25	...	...	...
SO ₃ ..	...	.23	...	...	...
P ₂ O ₅ ...	...	nil	...	...	...
Cl ...	...	.04	...	...	...
		100.27			
Calculated:					
CaCO ₃ ...	...	50.87	71.77	64.29	74.15
MgCO ₃...	...	40.01	18.36	13.24	9.29
Analyst	...	Rowledge	Kildahl	Kildahl	Rowledge

PHOSPHORUS IN FETID LIMESTONE.

A. Main Road, 50 yards South of R.P.F.	...	...	...	P ₂ O ₅ 0.026 per cent.
B. S. of Wandalong homestead ...	...	...	...	0.026 "
C. Main Road, 3½ miles North of R.P.F.	...	...	...	0.022 "

Analyst A. J. Hoare.

APPENDIX II.

COMPOSITION OF DRIFT SANDS.

No. ...	...	5545.	5546.	5547.	5548.
Particle size—		%	%	%	%
Over 20 mesh ...	...	nil	0.8	nil	nil
" 30 " ...	...	nil	4.1	nil	traces
" 60 " ...	...	22.0	41.9	16.6	40.0
" 80 " ...	...	38.5	14.7	28.5	29.9
" 100 " ...	...	13.4	7.0	13.2	7.4
" 120 " ...	...	11.0	4.4	9.3	4.3
Under 120 mesh ...	...	13.3	19.5	21.5	11.0
Silt ...	...	.3	1.7	.3	.6
Clay ...	...	1.5	5.8	5.1	5.1

Analyst: B. L. Southern.

5545. Top of large sandridge between Locs. 8360 and 8239. South Dartmoor.

5546. Undrifted sand plain at foot of ridge where 5545 was taken.

5547. Yellow drift from fallow, Wandalong Estate.

5548. Deep red drift from fallow, Wandalong Estate.

APPENDIX III.
ANALYSES OF WELL WATERS.

No. ...	5078.		5079.		5080.	
Source ...	240ft. Bore, Loc. 4995.		250ft. Bore, Res. 12648.*		16ft. Well, Loc. 7220.	
	Parts per million.	Grains per gallon.	Parts per million.	Grains per gallon.	Parts per million.	Grains per gallon.
Calcium carbonate ...	97	6.79	42	2.94	210	14.70
Magnesium carbonate	32	2.24	24	1.68	42	2.94
Magnesium sulphate ...	405	28.35	107	7.49	350	24.50
Magnesium chloride ...	200	14.00	8	.56	219	15.33
Sodium chloride ...	3,095	216.65	931	65.17	2,646	185.22
Potassium chloride ...	29	2.03	46	3.22	107	7.49
Sodium nitrate ...	4	.28	5	.35	69	4.83
Iron and aluminium oxides ...	4	.28	2	.14	6	.42
Silica ...	2	.14	4	.28	7	.49
Total ...	3,868	270.76	1,169	81.83	3,656	255.92
Reaction, pH ...	8.4	...	7.9	...	7.9	...
Total hardness ...	682	47.74	170	11.90	782	54.74

* Yields about 12,000 gallons a day. Analyst: J. Pericles.

APPENDIX IV.

TABLE 1.

CHEMICAL AND MECHANICAL

Lab. No.	Type.	No. of Loc. and Sample Site.†	Depth.	Mechanical Analysis.*								
				Stones	Coarse Sand.	Fine Sand.	Silt.	Clay.	Loss on Acid treatment.	Moisture.	Loss on ignition.	Calcium carbonate.
1932.			Inches.	%	%	%	%	%	%	%	%	%
5560	1A	9159	0-1	0	70.8	18.4	1.9	9.1	0.3	0.4	2.2	...
5561	"	(4)	1-5	0	65.3	21.8	2.3	10.3	0.5	0.6	2.5	...
5562	"	"	5-30	14	59.7	21.5	2.2	16.1	0.8	1.0	2.8	...
5563	"	"	30-52	20	48.6	27.4	5.1	8.4	7.1	2.5	6.6	5.7
5564			52-64	0	48.2	26.5	4.4	3.8	15.3	2.5	9.6	14.0
5611	1B	9211	0-3	0	54.7	27.5	5.1	11.3	0.4	1.1	2.6	...
5612	"	(10)	3-9	0	48.4	26.1	5.1	18.1	1.0	2.2	3.5	...
5613	"	"	0-24	0	39.2	24.8	2.5	25.8	5.9	2.8	6.1	5.1
5614	"	"	24-74	24	31.4	17.4	1.5	20.8	27.1	2.1	14.5	24.1
5805	1C	9201	0-2	0	50.7	24.2	6.6	18.0	0.1	0.8	3.5	...
5806	"	(13)	2-4½	0	54.3	19.7	6.3	18.6	0.4	1.0	4.0	...
5807	"	"	4½-12	0	45.3	23.0	8.5	22.0	0.4	1.3	4.2	...
5808	"	"	12-19	0	42.8	22.8	7.9	25.7	0.5	1.6	4.3	...
5809	"	"	19-26	10	49.9	22.0	6.5	16.4	1.5	2.7	5.8	Present
5615	1D	9202	0-2½	0	57.7	23.3	3.7	15.3	0.5	0.6	3.0	...
5616	"	(12)	2½-0	0	57.6	22.5	2.8	16.0	0.5	0.9	3.8	...
5617	"	"	0-11	0	54.4	24.8	3.0	17.5	0.6	0.9	3.4	...
5618	"	"	11-20	0	50.0	25.7	3.2	19.3	0.5	1.8	4.0	...
5619	"	"	Below 20	28	44.8	22.5	5.7	11.9	12.1	2.4	9.3	12.0
5145	1E	9104	0-1	0	67.0	19.6	3.2	9.9	0.4	0.3	3.4	...
5146	"	(1)	1-11	0	70.4	17.0	1.3	10.5	0.2	0.4	2.6	...
5147	"	"	12-30	0	57.6	25.7	2.1	14.7	0.2	0.4	2.6	...
5148	"	"	30-60	0	59.6	24.2	2.5	13.6	0.1	0.5	2.6	...
5149	"	"	60-79	0	62.4	23.2	2.3	11.3	0.2	0.6	2.4	...
5150	"	"	79-116	0	66.2	26.2	0.9	4.2	0.5	0.7	2.9	Present
1933.												
48	2A	5204	0-4	0	55.0	32.7	2.7	8.8	0.4	0.5	3.0	...
49	"	(21)	4-10	0	52.2	32.7	3.1	10.5	0.3	0.8	2.6	...
50	"	"	10-18	0	46.1	35.2	3.3	13.7	0.3	1.2	2.7	...
51	"	"	18-20	20	49.3	28.7	3.9	12.6	3.5	2.2	4.6	2.3‡
1932.												
5245	2B	5198	0-12	0	53.4	34.3	1.4	10.7	0.2	0.5	2.1	...
5246	"	(20)	12-30	0	49.3	36.8	1.7	12.8	0.1	0.6	2.0	...
5247	"	"	30-52	0	43.2	39.6	2.1	15.3	0.1	0.8	2.5	...
5248	"	"	52-60	0	39.8	35.3	5.4	16.3	1.1	2.1	3.8	Present
5275	1A	8772 (23)	0-6	0	44.6	45.2	1.7	6.9	0.4	0.6	2.0	...
5153	3A	North of 5207	0-2½	0	63.6	29.6	1.0	5.6	...	0.2	2.1	...
5154	"	(8)	2½-9	0	64.7	28.5	0.8	6.1	...	0.3	1.7	...
5155	"	"	9-30	0	61.4	30.9	1.2	7.0	0.1	0.3	1.8	...
5156	"	"	30-60	0	54.6	37.5	1.3	6.9	0.2	0.3	2.1	...
5157	"	"	60-104	0	52.2	40.8	1.5	5.9	0.2	0.3	2.2	...
5299	"	9204	0-4	0	69.9	25.6	1.1	4.3	0.1	0.2	1.6	...
5300	"	(11)	4-9	0	59.4	34.4	0.8	5.4	...	0.3	1.5	...
5301	"	"	9-30	0	57.4	36.7	0.6	5.7	0.1	0.3	1.6	...
5302	"	"	30-60	0	53.4	38.7	0.8	6.6	0.2	0.3	1.9	...
5303	"	"	60-104	0	48.3	44.0	1.2	6.4	0.3	0.3	1.8	...
5304	"	"	104-106	43	46.3	45.6	1.2	7.0	0.1	0.4	2.1	...
5565	3B	9170	0-2½	5	61.8	30.2	2.0	6.3	0.3	0.2	3.1	...
5566	"	(6)	2½-12	8	53.6	35.8	2.2	8.5	0.1	0.4	3.1	...
5567	"	"	12-21	62	48.4	39.4	2.0	9.8	0.2	0.4	3.2	...

* Mechanical analysis:—

Particle sizes:

Coarse sand 2 — 0.2 millimeters (over 70 mesh).
 Fine sand .2 — .02 " (under 70 mesh).
 Silt .02 — .002 " "
 Clay under .002 " "

† See accompanying Plan <
 ‡ Includes some MgCO₃.

APPENDIX IV.

TABLE I.

ANALYSES OF DARTMOOR SOILS.

		Chemical Analysis.								
Colour (wet).	Nature.	Reaction pH.	Nitrogen.	Organic carbon	Hydrochloric acid soluble.					Lab. No.
					Lime (CaO).	Phos. oxide, P ₂ O ₅ .	Potash, K ₂ O.	Water soluble salts.	Sodium chloride calc. from Chlorine.	
Dark red brown	Very sandy loam	6.91	0.024	...	0.057	0.076	0.121	0.025	0.008	1932.
Red brown ...	do. ...	6.44	0.023	...	0.070	0.047	0.140	0.020	0.010	5560
Do. ...	Sandy loam ...	7.34	0.024	...	0.131	0.054	0.237	0.048	0.012	5562
Do. ...	Coarse very sandy loam calcareous	7.64	...	...	...	...	...	...	...	5563
Pale red brown	do. do.	8.01	...	...	...	...	...	...	...	5564
Dark red brown	Very sandy loam	7.78	0.028	...	0.162	0.038	0.032	0.047	0.008	5611
Do. ...	do. ...	8.38	0.035	...	0.414	0.049	0.249	0.085	0.008	5612
Brown ...	Calcareous loam	8.43	0.028	...	3.215	0.042	0.233	0.158	0.079	5613
Light brown...	Calc. clay loam	8.14	...	...	...	...	...	...	...	5614
Dark red brown	Sandy loam ...	7.77	0.032	...	0.119	0.084	0.225	...	...	5306
Do. ...	do. ...	8.23	0.034	...	0.192	0.073	0.180	...	...	5306
Do. ...	Loam ...	8.23	0.029	...	0.215	0.085	0.253	...	...	5307
Red brown ...	Loam ...	8.11	0.025	...	0.076	0.019	0.058	0.049	0.008	5308
Do. ...	Sandy loam : hard CaCO ₃	8.46	0.032	...	...	...	...	...	...	5309
Dark red brown	Coarse sandy loam	7.12	0.030	...	0.157	0.071	0.106	0.052	0.008	5616
Do. ...	do. do.	6.21	0.042	...	0.102	0.051	0.121	0.064	0.007	5616
Do. ...	do. do.	4.92	0.028	...	0.064	0.075	0.082	0.038	0.008	5617
Do. ...	do. do.	6.46	0.034	...	0.144	0.071	0.090	0.180	0.007	5618
Do. ...	Coarse sandy loam. CaCO ₃	7.92	...	...	...	...	...	...	...	5619
Brown ...	Very sandy ...	6.71	0.041	1.335	0.163	0.047	0.028	...	0.014	5145
Red brown ...	do. ...	4.77	0.025	0.597	0.110	0.018	0.021	...	0.004	5146
Do. ...	Sandy ...	4.66	0.013	...	0.113	0.019	0.028	...	0.003	5147
Do. ...	do. ...	6.85	0.011	...	...	...	...	...	0.007	5148
Do. ...	Very sandy ...	7.25	nil	...	...	...	...	...	0.024	5149
Do. ...	do. ...	8.09	0.006	...	...	...	...	...	0.053	5150
Dark red brown	Very fine sandy loam	5.26	0.031	...	0.077	0.033	0.059	0.043	0.012	1933.
Do. ...	do. do.	5.26	0.028	...	0.050	0.047	0.055	0.087	0.036	48
Do. ...	do. do.	6.48	0.027	...	0.071	0.020	0.108	0.153	0.064	49
Do. ...	Sandy loam.	7.88	0.028	...	0.800	0.022	0.173	0.281	0.115	50
Do. ...	CaCO ₃ , MgCO ₃	...	...	...	...	...	...	...	...	51
Do. ...	Very fine sandy loam	5.33	0.019	196	0.102	0.026	0.062	...	0.007	1932.
Do. ...	do. do.	4.36	0.015	...	0.174	0.022	0.059	...	0.018	5246
Do. ...	Very fine loam	4.96	0.028	...	...	...	...	...	0.024	5247
Do. ...	Very fine loam, Tr. CaCO ₃	7.32	0.013	...	...	...	...	...	0.014	5248
Dark brown...	Very fine sandy loam	6.41	0.027	458	0.045	0.020	0.011	0.010	0.008	5275
Yellow brown	Coarse sand	6.50	0.015	379	0.048	0.061	0.014	...	0.004	5153
Do. ...	do. ...	5.93	0.015	224	0.065	0.015	0.016	...	0.003	5154
Bright yellow-brown	Coarse, very sandy loam	5.01	0.011	...	0.088	0.015	0.019	...	0.004	5156
Do. ...	do. do.	4.74	0.003	...	...	...	...	...	0.004	5156
Do. ...	do. do.	5.33	0.008	...	...	...	...	...	0.005	5157
Yellow-brown	Coarse sand ...	5.87	0.013	...	0.196	0.027	0.013	...	...	5299
Do. ...	do. ...	5.70	0.010	...	0.044	0.043	0.019	...	...	5300
Bright yellow-brown	Coarse, very sandy loam	6.61	0.007	...	0.227	0.042	0.151	0.017	0.008	5301
Do. ...	do. do.	6.37	...	...	...	...	...	...	...	5302
Do. ...	do. do.	6.74	...	...	...	...	...	...	...	5303
Do. ...	do. do.	6.59	...	...	...	...	...	...	...	5304
Pale brown ...	Sandy ...	6.06	0.034	...	0.058	0.083	0.034	0.021	0.005	5565
Yellow-brown	Very sandy loam	5.02	0.023	...	0.051	0.041	0.018	0.026	0.007	5566
Do. ...	do. ...	4.73	0.031	...	0.037	0.065	0.189	0.036	0.013	5567

Analysts: B. L. Southern, F. W. Steel, F. F. Alsop.

APPENDIX IV.
TABLE 2.
DARTMOOR SOILS—SIEVING TESTS OF COARSE AND FINE SAND FRACTIONS.

Type	1A.			1B.			1C.			1D.		
	Loc. 9159.			Loc. 9211.			Loc. 9201.			Loc. 9202.		
	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...
Coarser Sand	5560.	%	1.7	5561.	%	1.6	5562.	%	1.7	5563.	%	1.7
		%	8.8		%	8.8		%	8.8		%	8.8
		%	55.6		%	50.6		%	45.8		%	35.1
		%	7.0		%	7.2		%	6.6		%	7.3
		%	2.2		%	2.5		%	2.7		%	3.1
Finer sand	...	%	2.1	...	%	1.8	...	%	2.1	...	%	2.4
		%	11.2		%	13.9		%	13.9		%	13.9
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
Type	1E.			2A.			2B.			1A.		
	Loc. 9104.			Loc. 9204.			Loc. 5198.			Loc. 8772		
	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...
Coarser sand	5145.	%	4.2	5146.	%	6.4	5147.	%	7.7	5148.	%	10.4
		%	13.2		%	14.7		%	10.0		%	10.0
		%	46.4		%	47.0		%	40.3		%	40.3
		%	6.3		%	5.4		%	7.7		%	6.8
		%	1.7		%	1.5		%	2.3		%	1.8
Finer sand	...	%	12.1	...	%	10.4	...	%	17.4	...	%	17.4
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
Type	3A.			3B.			Wongan Hills			Standard Light		
	North of Loc. 5207.			Loc. 9204.			Loc. 9170.			Land Soil.		
	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...	Lab. No.	...	...
Coarser sand	5153.	%	6.4	5154.	%	7.6	5155.	%	7.4	5156.	%	8.7
		%	17.8		%	18.2		%	18.8		%	18.8
		%	35.8		%	35.3		%	31.9		%	27.4
		%	7.7		%	8.5		%	8.2		%	9.4
		%	4.0		%	3.9		%	3.5		%	3.5
Finer sand	...	%	2.9	...	%	3.5	...	%	3.5	...	%	3.5
		%	18.3		%	16.8		%	18.9		%	18.9
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...
		%	...		%	...		%	...		%	...

N.B.—The 80-mesh fraction in this table includes both coarse and fine sand; a 70-mesh screen being the standard sieve for separating these two fractions.

Analyst: B. L. Southern.

APPENDIX IV.

TABLE 3.

DARTMOOR SOILS—RATIOS BETWEEN CERTAIN MAJOR SAND FRACTIONS.

(Calculated from Tables 1 and 2.)

Lab. No.	Type.	Ratio of Percentages.	
		Coarse sand to Fine sand.	— 30 + 60 sand to Whole sand.
5580	1A	3.85	62.8
5561	"	3.08	58.6
5562	"	2.77	56.2
5563	"	1.77	45.6
5564	"	1.82	44.5
5611	1B	1.99	54.1
5612	"	1.85	51.8
5613	"	1.58	47.5
5614	"	1.80	49.9
5305	1C	2.09	47.2
5306	"	2.76	50.3
5307	"	1.97	45.6
5308	"	1.88	43.4
5309	"	2.27	35.8
5615	1D	2.47	34.1
5616	"	2.56	32.8
5617	"	2.19	32.1
5618	"	1.94	29.8
5619	"	1.99	30.3
5145	1E	3.42	54.1
5146	"	4.13	54.1
5147	"	2.24	48.4
5148	"	2.46	49.0
5149	"	2.69	48.2
5150	"	2.52	43.8
5648	2A	1.69	47.9
5649	"	1.60	46.0
5650	"	1.31	42.7
5651	"	1.72	44.7
5245	2B	1.56	50.1
5246	"	1.34	45.8
5247	"	1.08	39.4
5248	"	1.13	39.5
5153	3A	2.15	38.5
5154	"	2.27	38.4
5155	"	1.99	34.6
5156	"	1.46	31.7
5157	"	1.28	29.4
5299	3A	2.69	42.4
5300	"	1.72	39.7
5301	"	1.56	35.3
5302	"	1.38	29.0
5303	"	1.10	26.3
5304	"	1.02	23.5
5565	3B	2.05	40.4
5566	"	1.50	36.8
5567	"	1.23	32.9
Wongan Hills sand heath soils from Experiment Farm		2.30	30.5
		1.87	31.9
		1.88	31.2
Averages—			
Dartmoor		2.02	41.8
Wongan Hills		2.02	31.2

APPENDIX IV., TABLE 4—continued.

[illegible]

* Site 16: From "Crab-hole"; Contains also 0.015 per cent. of salt.

Analysts: B. L. Southern; F. W. Steel.

APPENDIX IV.

TABLE 5.

DARTMOOR SOILS—FIELD TESTS FOR REACTION AND WATER SOLUBLE SALTS.

Serial No.	Depth.	Reaction.	Soluble Salts.	Soil Texture.	Notes.
	Inches.	pH.	%		
33	0—24	6.38	Trace	Reddish sand	Small rise—scrub and mallee
34	0—18	4.43	Trace	Brown sand	Scrub, jam, casuarina, etc.
	below 18	4.75	Trace	Red, brown sand	
35	0—7	8.19	0.75	Red-brown sandy loam	Salt bush and York gum in clay pan reserve
	7—16	7.38	0.41	Red-brown loam	
36	0—10	8.09	0.015	Red-brown loamy sand	Yorrel, centipede saltbush scrub
	10—20	8.55	0.056	Red-brown loam	
	20—30	8.23	0.33	Red-brown clay loam	
37	0—10	8.38	Trace	Brown fine sand (calcareous)	Yorrel, etc.
	10—20	8.17	0.056	do. do.	Loveland's farm
	20—28	8.14	0.17	Light brown calc. loam	
38	0—30	7.75	Trace	Red fine sand, probably wind blown	Mallee scrub and spinifex
39	0—2	8.29	Trace	Brown fine sand	York gum, grey centipede bush, salt bush
	2—16	8.86	0.01	do. do.	
	16—28	8.26	0.07	Brown fine loamy sand, calcareous	

With the exception of No. 37 these soils were all taken from the Wandalong Estate.

APPENDIX V.

TABLE 1.

WHEAT ANALYSES, DARTMOOR—1932 CROPS.

Variety.	Place Grown.	Moisture.	Nitrogen.	Protein A.†	Protein B.†
Bencubbin	Government Loc. 9104	9.61	1.79	10.43	10.38
Merredin	do. ...	10.89	1.73	10.08	10.18
Nabawa	do. ...	11.03	1.92	11.19	11.32
Noongar	do. ...	9.97	1.69	9.85	9.84
Glucub	Wandalong ...	9.80	2.15	12.53	12.50
Totadgin	do. ...	8.76	2.07	12.07	11.91
Nabawa*	do. ...	10.66	2.11	12.30	12.89
Noongar	do. ...	11.14	1.90	11.08	11.22
Centenary	do. ...	10.56	2.10	12.24	12.30
Canberra	do. ...	10.83	2.07	12.07	12.18
Merredin*	do. ...	10.81	1.85	10.79	10.89
Grosley	do. ...	11.12	2.32	13.53	13.70
Bencubbin*	do. ...	10.66	2.09	12.19	12.28
Merredin (1930 crop)	do. ...	9.76	2.10	12.24	12.21
State F.A.Q. Wheat, 1932 ... ..	... ..	11.00	1.74	10.14	10.25

* 150 points of rain fell in December on these wheats after they had ripened and before they could be harvested. Other varieties were stripped before this fall.

† Nitrogen x 5.83. A. is protein content of wheat in natural condition; B. protein calculated to uniform moisture basis of 10.0 per cent.

APPENDIX V.

TABLE 2.

MILLING TESTS AND ANALYSES OF DARTMOOR WHEATS, 1932 CROP.

Description.			Grain Analysis.			Milling Results.			
Variety Plot.	Class.	Con- dition.	Mois- ture.	Bushel Weight.	Weight of 1,000 grains.	Ease of Milling.	Flour.	Bran.	Pol- lard.
Merredin	Strong ...	Clean	10.2	lbs. 63½	grams. 36.1	hard	71.5	19.7	8.8
Merredin	Strong ...	Clean	11.2	64	37.6	hard	71.5	19.7	8.8
Glucub Wandalong	Soft weak	Clean	10.3	63½	31.6	easy	69.2	21.1	9.7
Bencubbin	Medium	Clean	9.8	63½	42.8	hard	71.8	19.8	8.4
Bencubbin Government	strong	Clean	11.0	58½	42.6	hard	72.2	19.5	8.3
Bencubbin Wandalong	strong	Clean	11.0	68	38.8	easy	71.0	19.6	9.4
F.A.Q., 1932-33 ...	...	...	11.0	68	38.8	easy	71.0	19.6	9.4

APPENDIX V., TABLE 2—continued.

Description.			Wholemeal Analysis.			Flour Analysis.					
Variety Plot.	Class.	Con- dition.	Protein* N x 5.83	Pelshenke test.		Mois- ture.	Ab- sorp- tion.†	Mal- tose figure.	Buffer index.	Colour Pekar Mean of 3.	Petrol Ex- tract. ‡
				Time.	Quality.						
Merredin	Strong ...	Clean	10.3	min. 150	14.9	12.5	55.8	1.58	1.5	4.8	6.0
Government	Strong ...	Clean	11.2	140	12.8	12.0	55.5	1.65	1.6	4.8	8.0
Merredin	Wandalong	Soft weak	13.1	152	11.9	11.8	51.5	1.07	1.6	4.8	6.0
Glucub	Wandalong	Medium	10.3	148	14.7	12.2	54.6	1.55	1.7	4.7	10.0
Bencubbin	Government	strong	12.7	148	11.9	11.5	54.7	1.31	0.9	4.5	7.0
Bencubbin	Wandalong	strong	10.25	150	15.0	12.8	53.0	1.46	1.3	5.0	7.0
F.A.Q., 1932-33 ...	...	...							

* The wheat protein figure is calculated to a standard moisture basis of 10.0 per cent.

† The flour absorption figure and maltose calculated to standard moisture basis of 12.0 per cent.

‡ Kent Jones' method.

Analyst: R. G. Lapsley.

THE STORAGE OF POTATOES.

W. E. COLLINS, Potato Branch.

There is very little data on the storage of potatoes in this State, and reference has had to be made to the methods obtaining in other countries. Hitherto, the necessity had not arisen for a close study of this phase, by reason of the almost continuous movement of this commodity, but, due to the ever increasing growth of the industry, the time is considered opportune to give some attention to this very vital subject.

The object in the storage of potatoes is that of prolonging its edible quality throughout a longer period of time, thereby enabling the grower or the merchant to dispose of the crop at such time as the requirements of the trade demand, and by so doing avoid marketing it when there is an over supply and consequently low prices.

Growers have held seed potatoes in sound condition throughout the hot months of November, December, and January by means of cool airy sheds, and under shady trees, but ware potatoes intended for domestic use require somewhat different treatment. For instance, potatoes intended for seed must have light, whereas potatoes stored for future consumption must be kept from the light.

Light has a curious effect on potatoes. Solanum is developed, and the skin and the flesh of the tubers turn green—the longer the exposure the deeper the green. This greening is effected to the very centre of the potato, and is not confined to the surface layer of the flesh. In this green condition the tubers are bitter to the taste and actually poisonous—in fact, stock have died through eating greened potatoes to which they have had accidental access.

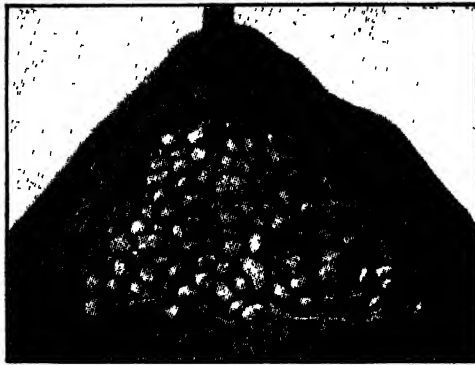
The type of storage to which consideration will be given in the ensuing article is that of pitting. Strictly speaking the term pitting is somewhat misleading, since it does not necessarily imply an actual pit in the ground, as will be noted in

the accompanying self-explanatory illustrations. It is a cheap form of storage, and when sound potatoes are pitted in this manner there is practically no risk involved, as they are almost certain to come out in good condition when required.

It would appear that the successful storage of potatoes is dependent upon a number of factors, among which may be mentioned drainage, ventilation, soundness of tubers stored and freedom from dirt and moisture.

In the pitting of potatoes, drainage is the first essential to be aimed at. The land must either be well drained naturally, or else so situated as to make good drainage possible.

Adequate ventilation of the pit is of supreme importance in maintaining the tubers in a sound and healthy condition. The temperature of storage for domestic use should be 45 degrees F. or as near this figure as is possible. When potatoes are first pitted every effort should be made to reduce the temperature quickly. This is particularly desirable if the weather is warm when they are dug, as they absorb heat rapidly, and also develop heat rapidly when stored in bulk. In natural storage this is most easily accomplished by the prompt attention to ventilation and



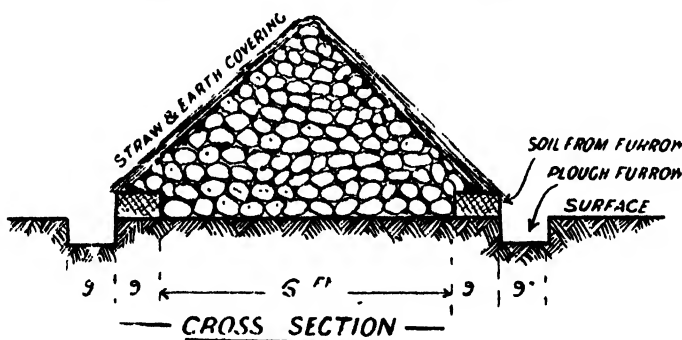
Cross-section of potato pit.
English method.

insulation of the pit. A good practice is to construct a small ventilation shaft of six to eight inches square out of inch timber. Bore numerous holes an inch or so in diameter in the lower portion of the shaft, and insert it in the centre of the pit as the tubers are being pitted. It should extend two or three feet above the tubers, so that when the final covering is applied it will protrude 12 to 18 inches above the ridge. The ventilator should be provided with a cap to prevent the entrance of rain. If the pit is more than ten feet in length a second ventilator should be inserted. A proved rule to follow is to have a ventilator every eight feet. This assures reasonably good ventilation of all portions of the pile. It would be as well if the grower occasionally lowered a thermometer down one of the shafts and tested the heat of his pit.

Soundness of tubers stored.—One of the most prolific sources of loss in storage is that resulting from the storage of unsound tubers. Unsound tubers may be classified under two heads:—those that are mechanically injured, such as bruised or forked potatoes, and those that are infected with disease, such as Late Blight. Ordinarily the Late Blight has been our most serious storage trouble, and in districts where this disease is likely to be prevalent, it should be so controlled by the thorough spraying of the growing plants as to effectually prevent tuber infection.

The presence of cut and bruised surfaces offer an easy point of infection for a number of storage decay organisms; therefore, the more carefully that potatoes are harvested and stored, the better will be their keeping qualities, and the less the shrinkage.

Freedom from soil and moisture.—Whilst it is recognised that it is not always possible to harvest the potato in such condition as to ensure freedom from any unusual amount of soil it is believed that, in so far as it is consistent with the safety of the crop, harvesting operations should be so timed as to ensure a minimum amount of soil adhering to the potatoes. It is not good practice, if obliged to dig the crop when the soil is too wet, for good results to gather the tubers as soon as they are dug. Advantage should be taken of every opportunity to leave them exposed to the sun and wind for an hour or more in order to allow the excess moisture to dry off, and to get rid of as much dirt as possible. When potatoes are stored with large quantities of moist soil adhering to the tubers, they are almost certain to develop a considerable amount of heat, especially if stored in bulk. It requires very little imagination on the part of any thinking grower to figure out that the potatoes stored under such conditions are much more likely to decay; and if no decay does occur, to realise that when tubers are subjected to such high temperatures, sprouting is induced and the chance of losses is very greatly increased. Let us not forget then that dirt and moisture are undesirable factors in potato storage, and make every effort to store clean and dry potatoes.



Potato Pit.

Victorian.

A simple method of making a pit as practised in Victoria is to turn up by plough or spade two furrows parallel to each other with a space of eight feet between them (inside measurement). Let it be in an East-West direction, so avoiding the direct rays of the sun on either side. The empty furrow space of course being on the outside of the pit, acts as a drain, and provision should be made for the escape of water from it. The upturned sods form the side of the pit and keep the potatoes together, the ends may be made either square by stacking or rounded off. Build up the pile as steeply as possible, this to shed the rain, and as soon as the potatoes are in position they should be immediately covered with a sufficient quantity of straw, hay, rushes, or other straight litter to exclude light; a thin layer of soil may be added to within a foot of the ridge, this to retain the covering in position. The pitted potatoes should be left in this condition as long as they are safe from heavy soaking rains. This gives them a chance to go through the sweating process and get thoroughly cooled off, a most important point. After which there is little danger from heating and sweating when the final covering is applied in from two to three weeks time.

In this final operation you will be insulating against heat, and not cold or frost. Most other countries have to protect against freezing, but this latter holds out no difficulties in this State. Our problem is to keep the stored potatoes cool, and every effort should be made to bring this about, even if one has to make a light awning from old bags and suspend same on stakes to break the heat of the mid-day sun. This will well repay the trouble taken. Cold conditions inhibit sprouting, arrest decay, and if the potatoes are infested with potato moth larva no damage need be apprehended from a re-infestation. So, if the covering is brought up to eight inches or so in thickness, inclusive of a moderately even layer of soil, all should be well.

For conclusion it may be quoted that at Osborne Park where a grower requires his land urgently for a rotation crop of another vegetable, the potatoes are dug and successful storage is obtained for short periods by this system of pitting. Again, a grower at Young's Siding has experimented in this direction for the past three seasons and claims to have held potatoes in excellent condition for a period of three to three and a half months.

It may also be assumed that there are many other growers who have a knowledge and have even practised the storage of potatoes, but it is not the purpose of this article to advocate the general storage of this commodity. Main crops are being dug from October to the following May, and to have a carry over from the first diggings would hamper rather than help the industry. Rather is it written for those harvesting their crops from March onwards. From an inspection point of view it is in this latter part of the season that potatoes come forward greened, wilted, and showing every evidence of bad storage conditions, when, if only some part of the crop had been stored under the method outlined, a much more marketable article would have been the case, giving satisfaction both to the trade and the consumer.

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RABBIT BAITS AND STOCK POISONING.

A. ARNOLD, Chief Inspector of Rabbits.

On account of the large losses of stock last year owing to the prevalence of toxic paralysis, many settlers, especially those in the inner areas, are inclined to the opinion that the stock died, not from toxic paralysis, but from picking up and eating old phosphorised pollard rabbit baits.

The baits would certainly be poisonous to all classes of stock if picked up shortly after being laid. It has, however, to be realised that the phosphorous in the bait becomes oxidised, and therefore less and less poisonous with the passage of time, until at last it is quite harmless. With normal baits this condition is reached in about seven days.

It is largely because of this change in the action of the phosphorous that has caused this class of bait to be so universally used throughout the whole of Australia. It means that baits can be laid in a wholesale way over a large tract

of country and, as in the course of a few days such baits are rendered innocuous, stock may be returned to the paddock without any harmful results, and there is no need for the farmer to pick up the baits, which would be the case if strychnine or arsenic baits had been employed. These baits would remain poisonous for all time.

Some years ago Dr. Stoward conducted some experiments with ordinary phosphorised pollard baits during the middle of summer, and found that such baits were innocuous after being laid two days.

Recently an investigation was conducted regarding some sheep losses in the Beverley district when a few sheep died after being placed in a paddock which had been previously poisoned with phosphorised baits and it was thought death was due to picking up of such baits. Some of the baits were brought to Perth and analysed and were found to contain a small percentage of free phosphorus, so small in fact that a sheep would require to take 1,000 of these baits in order to receive a toxic dose.

However, with a view to definitely determining the toxicity of normal baits after being laid seven days, a definite experiment, under the control of Dr. Bennetts, was carried out by the department during April of last year. This is rather a cool period of the year when baits would be liable to remain poisonous for a longer period than in the summer. The baits were the ordinary sized baits as laid by a poison cart, being three-quarters of an inch long and as thick as a lead pencil. They were left in the paddock for seven days as recommended by the department and then forwarded by post in air tight tins and fed to rabbits as follows:—

1. Batch No. 1, laid 4/4/33, picked up 11/4/33—

Rabbit No. 1—

On 12/4/33 fed 6 baits.

On 13/4/33 fed 12 baits.

On 19/4/33 fed 7 baits.

Baits were stored in air-tight containers until fed. All baits were eaten. The rabbit showed no sign of illness.

2. Batch No. 2, laid 4/4/33, picked up 13/4/33—

Rabbit No. 2—

On 19/4/33 fed 12 baits.

On 20/4/33 fed 12 baits.

All eaten. The rabbit showed no sign of illness.

An enormous number of phosphorised baits are laid in the outer districts of the Eastern Wheat Belt; in fact, more are laid in that area than in any other portion of the State. This has been going on for a number of years yet one rarely hears or receives reports of loss of stock due to poison baits from these areas. Where, however, rabbits, have only recently become numerous, necessitating poison being laid, settlers are very dubious, and if any stock die, no matter from what cause, death is invariably attributed to the stock having taken a poison bait, where of course, such has been laid. Numerous investigations by veterinary and other departmental officers, however, have shown death to have been due to other causes, mainly toxic paralysis.

It is interesting to record that prior to the laying of rabbit poison, when stock died from unknown causes it was invariably attributed to the chewing of bones of game, etc., that had been poisoned with strychnine for dogs, and it was then claimed that such stock died from strychnine poisoning. This is now generally recognised as erroneous and is on all fours with the contention that the loss of stock is due to their eating rabbit baits.

It should be remembered, however, that it is most important and necessary to adhere to the directions when mixing baits; the proper amount of water to allow for the gradual oxidation of the phosphorus is specified. Many depart from the prescribed formula, in some cases to advantage. It is generally known that rabbits are fond of a sweetened bait and all formulae provide for this, and to this end extra molasses is at times added to that already in the tin. Such a bait will certainly be more readily taken, but when this is done less water is required for the mixing, resulting in a heavier form of liquid being mixed with the pollard. This materially retards oxidation of the phosphorous and such baits would remain poisonous for a much longer period. If the pollard were mixed wholly with molasses it can easily be seen that the bait will remain poisonous for a very long time indeed.

A farmer reported that during the last five years he poisoned according to directions and placed sheep in the poisoned paddocks 10 days after laying the baits without ever having had any losses. He was recently advised by a neighbour that the baits would be more attractive if additional molasses were added. He found this correct and subsequently turned his sheep into the paddock as previously and lost a number, the symptoms indicating phosphorous poisoning.

In some cases, also, it is the custom to mix the poison at double strength. It can easily be seen that such baits will retain more free phosphorous and thus remain poisonous for a considerable period and be more harmful than if properly mixed. A normal bait freshly laid contains .045 grains of phosphorous; the toxic dose of phosphorous for a sheep is 2 grains thus a sheep would have to ingest 45 freshly laid baits in order to obtain a toxic dose.

Another frequent departure from the directions is the omission of the bran (three parts pollard and one part bran is recommended). The main reason for the addition of the bran is to cause the better disintegration of the bait, and when pollard only is used, free oxidation of the phosphorous is retarded. Some pollard is of a coarse nature, other again is fine like flour. This latter has a tendency to form a hard coating on the outer surface which delays oxidation to a certain extent. The addition of the bran effectively overcomes this tendency, hence the utmost importance to adhere to directions.

With the exposure of the bait the phosphorous oxidises with the passing of time, rendering the baits less and less poisonous and the department's recommendation is to keep sheep out of poisoned paddocks for at least a week or ten days during the summer, and changing weather conditions might even lengthen this period.

It can therefore be seen that at the expiration of a week or fortnight, an enormous number of baits would need to be ingested to cause any harmful results. In fact, numerous trials of baits mixed in accord with directions and laid in the field for a week have been undertaken without any harmful results when fed to rabbits, but if directions are not followed or the formula added to in any way, conditions would naturally be altered.

FOLIAGE BAITING AND TRAPPING FOR THE CONTROL OF FRUIT FLY.

By L. J. NEWMAN,
Government Entomologist.

The following are recommended as suitable foliage baits and trapping lures for the control of fruit fly.

Juice of one dozen ripe oranges or mandarins (windfalls will do)—

4 lbs. of molasses or treacle;

5 ozs. paste arsenate of lead or $2\frac{1}{2}$ ozs. powder
arsenate of lead;

Water to make four gallons.

Method of making.—Squeeze out the juice of the oranges into a kerosene tin or other vessel. Dissolve the molasses or treacle in one gallon of water, then add the fruit juice. To this add the arsenate of lead, reduced by the addition of water to the consistency of milk. Mix the ingredients thoroughly, adding the required amount of water. When using keep well stirred.

Alternative Formula.—When it is impossible to obtain orange or other citrus fruit juice, fruits in season or rock melon juice may be used. It has been proved that the best results follow the use of a bait giving off an orange aroma.

Boil 4 to 6 lbs. ripe fruit in one gallon of water until reduced to a pulp. Prolonged boiling only tends to weaken the aroma, and is otherwise of no advantage. When sufficiently soft, mash and strain off the liquid. Dissolve in one gallon of water 4 to 5 lbs. of molasses or treacle. Reduce 5 ozs. of paste arsenate of lead or $2\frac{1}{2}$ ozs. powder arsenate of lead to the consistency of milk. Mix the three ingredients together thoroughly and add sufficient water to make four gallons.

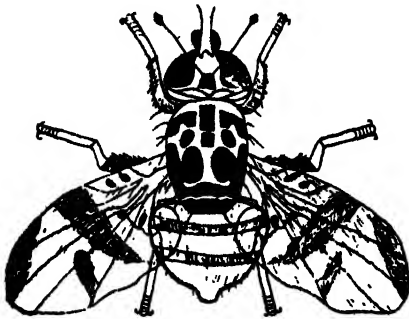
When using either formula, keep ingredients well stirred. Windfalls and maggot infested fruit may be used provided that the fruits have not fermented or gone mouldy. Only sufficient bait should be mixed for daily use. If the mixture is kept for more than 48 hours, fermentation will take place. The fermentation will produce acetic acid, which will have the effect of freeing the arsenic in the arsenate of lead, and thus injure the fruit and foliage. No fermentation takes place after the bait is applied to the foliage, but only when the combined solution is held in a vessel.

The first application of the bait should be made 7 to 8 weeks before the fruit is expected to ripen, and every 6 to 8 days thereafter until the fruit is stripped. When the fruit is stripped make two more applications of bait to the trees at intervals of 12 to 14 days. After heavy rain renew bait. In hot weather apply the bait more particularly to the undersides of the leaves in shady positions. In winter apply to the sunny sides of the trees, north and west, in equal quantities to upper and under sides of foliage.

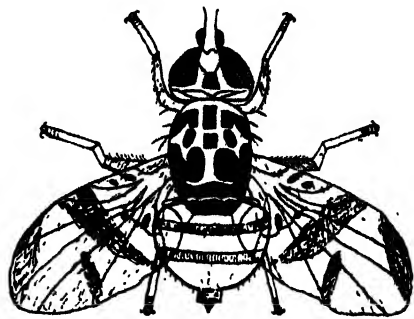
In distributing the bait avoid the fruit as far as possible.

An effective bait is made, by replacing the arsenate of lead, with $\frac{1}{2}$ oz. of arsenate of soda to each gallon. This, owing to its foliage burning qualities, should not be applied direct to the tree. The method adopted is to apply it to bunches of eucalyptus or other suitable foliage and hang in the fruit trees, seeing that it does not come in contact with the fruit or leaves.

Small bags of bran, soaked in this solution and suspended in the trees, will keep moist for a considerable time and act as effective poisonous lures.



Male



Female.



Egg



Larva



Pupa.

Fruit Fly:

Ceratitis capitata: (Weid.)
x 8 Times.



TRAPPING OR LURING.

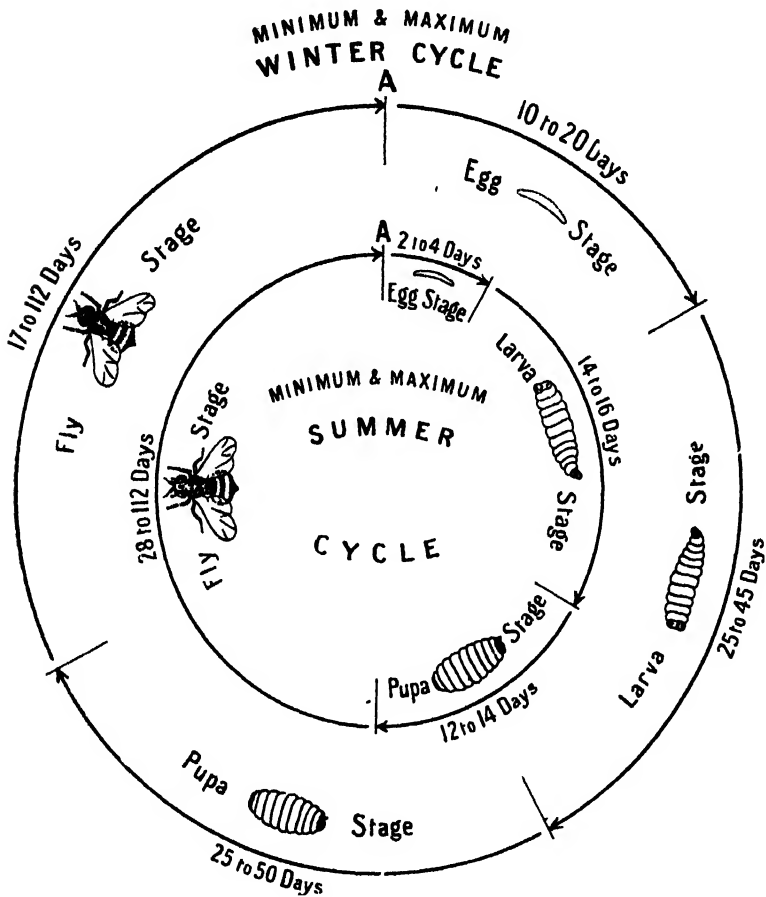
Pollard and Borax Mixture.—8 ozs. pollard, 6 ozs. powdered borax, 1 gallon of water.

Mix thoroughly and steep overnight, again shake or mix well and allow to settle. Draw or syphon off the clear amber coloured liquid discarding the residue, which should be buried. If desired, $\frac{1}{2}$ oz. of arsenate of soda may be added to each gallon of the lure.

Clensel Lure.—One part of clensel to 30 parts of water.

A locally made insecticide, under the name of "Beeco," has given equally good luring results, and is recommended at a strength of 1 part to 40 parts of water.

These lures should be used in $\frac{1}{2}$ pint lever lid tins or in glass jars. These should be half filled with the luring medium. Renew lure every 7 to 10 days or whenever traps have, from any cause, dried out. At least two traps per tree should be used, the more the better. Luring or trapping is recommended for gardens containing up to 200 trees. In larger orchards, they should be employed as indicators and when flies are captured, the foliage bait should be applied.



Traps can also be used to great advantage throughout the winter and spring months to capture the over-wintering fruit flies.

Take every advantage throughout the winter and spring to destroy the fruit fly, realising that these are the progenitors of the summer and autumn swarms. One pair of fruit flies then got rid of, are worth thousands captured or poisoned later on. It is far easier to control this pest during its minimum period, than when at its maximum.

Pick all maggot infested fruit from trees and ground daily and destroy same by boiling.

THE BDELLID MITE.

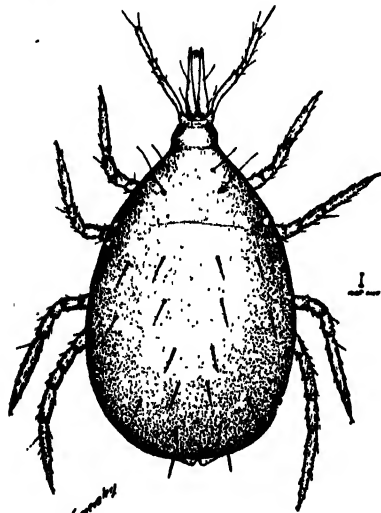
L. J. NEWMAN, Government Entomologist.

The Bdellid Mite (*biscirus lapidarius*), a predatory parasite of the Lucerne Flea (*Smynturus viridis*), was discovered at Waroona during July, 1931, by Mr. H. Womersley, Entomologist of the Entomological Branch of the Council of Scientific and Industrial Research. This was brought about by our attention being drawn by Mr. Weller, of Waroona, to the fact that the flea had been progressively decreasing in certain parts of his property.

Shortly after the finding at Waroona, it was observed at Denmark and Burekup. These areas, particularly Waroona, were kept under constant observation, to determine, if possible, what actual controlling value this mite had over the flea.

No attempt was made to spread the parasite during the winter of 1931, except that a colony was introduced into and established in the Insectary Grounds, Perth.

The observations made certainly indicated that the predator was worth following up the next winter. It must be understood that the Bdellid Mite, like its host the Lucerne Flea, is only active during the period from May to the end of September, except in very moist and cool locations, when the active period may extend to the middle or end of October. With the advent of dry and warm conditions, both host and parasite produce or lay over-summering or aestivating eggs. These remain dormant throughout the dry season, hatching out upon the advent of autumn rains. There is at most only an active period of six months.



Biscirus lapidarius (Kramer).

One of the Snout-mites (*Bdellidae*), predatory on the Clover Springtail (*Smynturus viridis*).

During the winter of 1932, further field and laboratory studies of the Bdellid Mite were made. The results were still more encouraging, as it was proved that in the areas under observation the parasite had increased considerably, with a corresponding decrease of the pest.

To further test the proposition, colonies were collected and placed at Guildford, Cannington, Muresk Agricultural College and Denmark State Farm. In each instance the colonies so placed became established, with the exception of those placed at the State Farm, Denmark. This colony was destroyed as the result of a flood.

In the "Journal of Agriculture" of June, 1932, a short illustrated article describing the Bdellid Mite was published.

During the 1933 season the work of spreading this beneficial mite was further advanced. With the assistance of Mr. Currie, a senior entomologist of the Council of Science and Industry, a more intense survey of the position was

undertaken and it was found that the predator was more widespread than was expected. As a matter of fact the surveys showed that the mite was to be found in many areas along the coastal plain between Perth and Bunbury and it was

widespread around the Northam, Muresk, York districts. It has also been found in the Chittering Brook and Chidlow districts and no doubt further surveys would reveal its presence in other areas.

This beneficial mite cannot be bred up in cages, but has to be collected in the fields, entailing considerable time and close work. To enable the collecting to be done as economically as possible, we have used small aspirators and by means of these the mites are sucked up into tubes and distributed. During the months of July to September inclusive, colonies were supplied to 70 local applicants. Each colony contained 100 or more *Bdellid* Mites, a total of 7,000.

Colonies totalling 2,910 mites were forwarded to South Australia, 3,220 mites to Victoria and 2,420 mites to Tasmania, a grand total of 15,550 mites.

Owing to the advent of early warm dry weather in September, the predator and its host the flea were greatly reduced. This prevented any further distribution until next wet season.

It is too early yet to definitely state whether this predator will do equally well in all districts. To date, it appears most active in the moist flat plains of the coastal areas. In the Northam-York districts it has not yet become apparent in large numbers and consequently has not depressed the flea population to the same extent.

There appears to be little doubt that where it is found in numbers, this predator is a positive limiting factor of the flea.

Every effort has been made and is being continued, to assist in the spreading of this beneficial predatory mite. It has to be realised, however, that the nature of the work renders this distribution difficult and slow.

The work is still in the experimental stage as far as the adaptability of the parasite to all areas where the flea is found.

GREEN TOMATO BUG.

Observations on the Bionomics of the Green Tomato Bug, *Nezara viridula* Linn, with remedial measures. Also a short account of the introduced egg parasite, *Micro-phanurus megacephalus*, Ashmead.

By L. J. NEWMAN, F.R.E.S., Government Entomologist, and
B. A. O'CONNOR, B.A., B.Sc. Agr.

The Green Tomato Bug was first recorded in this State in the year 1920. It was found to be attacking tomatoes, potatoes, beans, and other vegetable and garden plants, around the port of Bunbury.

On the pest being discovered, prompt warnings were issued through the Press, advising the public of the potential powers of destruction possessed by this insect and the danger of allowing it to spread. Like many other warnings, it went unheeded, with the result that the Green Bug to-day is found all over the coastal and hills areas of the South-West and now constitutes a major problem. Once introduced into a district, it rapidly spreads, by means of its own powers of flight.

This bug was described by Linnaeus in Europe as far back as 1758. It is recorded from Europe, Asia, Africa, North America, India, New South Wales, Queensland and Western Australia. Like all the plant feeding bugs, it is a sap sucker.

The plants observed to be seriously attacked are beans, tomatoes, potatoes, egg plants, lucerne, maize, peas, cotton, silver beet, cabbage, cauliflower, rhubarb, pumpkin, rock melon, citrus fruits, pears, stone fruits, grapes, amaranthus, dahlias, celosias, cosmos and many other garden plants and shrubs. It is most cosmopolitan in its selection of food plants.

In 1926 an illustrated account of this bug was published and afterwards published as Leaflet No. 179.

In January, 1932, a further and more accurate study of the life history and habits of the bug in this State was commenced. This was considered desirable, because it might lead to an improvement in methods of control, of what has become one of our major insect problems and also because of the contemplated introduction of parasites from America and Egypt. Owing to the resignation of Mr. O'Connor the project was interrupted, so that the data presented is somewhat incomplete.

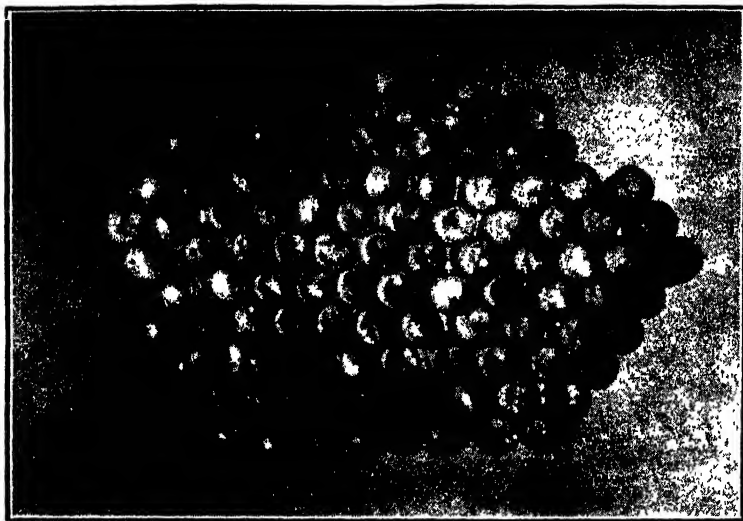
Breeding Technique.—Considerable difficulty was experienced in attempting to breed the bugs in a healthy condition and at the same time observe the life history of individuals. Egg laying was obtained by placing adult bugs on potted amaranthus, a favoured garden food plant, covered with a wire gauze cylinder. Attempts were then made to rear the young nymphs on growing plants, using bamboo cages to confine them as employed by Van der Merwe for the study of *aphis leguminosa*. This method proved unsuccessful, the nymphs dying in a few days. Finally, glass tubes six inches long and one inch in diameter were successfully used, the open ends being stopped with cotton wool and fresh food supplied daily. The bugs developed under these conditions, but they were not robust and the bulk of them died in attempting to cast the last nymphal skin. This trouble was probably due to the nature of the food, which consisted of stems and leaves, whereas under natural conditions the insect shows a decided taste for fruits. On the 24th April, 1932, numerous adults and fifth instar nymphs were placed in lantern glass jars with cheesecloth tops and fed on tomato fruits. They flourished well on this diet and at the end of July, a period of 10 weeks after being placed in the jars, most of them were still alive and healthy.

The tomato plant without the fruit is not a successful breeding medium. Several attempts were made at various times to breed third instar nymphs on growing tomato plants, with the result that they died within a very short time. This fact is very interesting, as the tomato crops are very severely damaged by this bug. It would appear that the bugs do not breed upon the young tomato plants, but invade the crop after the fruit has formed. This point has not been definitely decided by observations in the field.

On 5th September, 1932, eighteen pairs of bugs found copulating in the field were taken into the laboratory so that their copulation and oviposition could be observed. These were placed in cardboard boxes 3in. x 1¾in. by 1¼in., from which, with the exception of a marginal edge, the sides, top and bottom had been cut out. The sides and bottom were covered with cheese cloth and the top with cellophane which made very useful observation cages. A loose piece of blotting paper was placed in the bottom to absorb the excreta. Food was supplied daily. Small wire gauze cylinders 2in. deep x ¾in. wide and corked at one end, were used during experiments on the winter feeding of the bugs.

Eggs.—The eggs of the bugs, which are creamy coloured when laid, are cylindrical in shape and rounded at the bottom. They are deposited in clusters or rafts consisting of regular rows. The eggs are stuck to one another and to the leaf on which they are placed, by a colourless, glutinous substance. In almost every instance they are laid on the back or under surface of the leaves.

PLATE I.



Typical egg mass of Bug. Enlarged original.

The number of eggs in a cluster or raft varies from 30, up to as many as 87 and in odd instances as many as 100. The counting of 20 egg clusters gave the following number of eggs:—30, 38, 38, 41, 51, 53, 54, 54, 56, 60, 64, 68, 70, 70, 72, 73, 75, 76, 86, 87. Bugs in captivity were observed to lay as few as 10 eggs in a cluster and occasionally they were laid in twos and threes, or even singly.

On several occasions bugs confined on potted plants were observed to suck the eggs. This has also been noted in the field, the males being the culprits.

As the eggs develop, the colour changes from cream to yellow and then to orange red. At an early stage a red mark appears on the top of the egg and later the dark burster becomes visible. Finally the circular operculum or lid of the egg is pushed off by the action of the egg burster and the young nymph emerges.

The first eggs for 1932-33 season were found in the field on September 22nd. There were 70 eggs in the cluster, pale in colour and evidently just newly laid. These eggs did not hatch until October 11th, a period of 19 days. Eggs laid on potted plants in November hatched in 11-12 days, and those laid in February 5-7 days.

A point of considerable interest about the eggs laid in February was that of several clusters laid within a few days of one another, one cluster hatched in five days, another in six days, and a third in seven days. The duration of the first nymphal stage after emerging from the eggs was five, four, and three

days, so that the time from the laying of the eggs to the first moult was in each case 10 days, although the eggs hatched at various periods of from 5-7 days.

Nymphs.—The newly emerged nymphs in their first instar, are of a general yellowish red colour, with black markings, in the form of a band around the front and sides of the thorax and dots down the mid dorsal line of the abdomen and a white patch at each side of the base of the abdomen. The eyes are crimson. These colours quickly darken. Body length 1/16th inch.

These first instar bugs remain clustered on the empty egg mass until after the first moult, when they cease to be gregarious and scatter over the host plant. The period between the hatching and the first moult occupies from four to five days (November, January) and two to three days (March, May).

If the leaf to which the empty egg mass is attached is removed from the plant, the drying of its tissue causes these first instar bugs to migrate to moister surroundings.

PLATE II.



Second instar Bug. Enlarged. Frogg.

Second instar.—This state follows the first moult and occupies a period of six to 24 days (November, January), and 11 to 20 days (March, May). The bugs appear from this moult with head and thorax brown to black and two light spots on each side of the marginal edges of the thorax. The abdominal portion is reddish with a varying number of yellowish or whitish markings. Down the centre of the abdomen, are three lateral black markings, the marginal edge having a number of small white dots. Legs and antennae black, length $\frac{1}{8}$ in.

Third instar.—Follows the second moult and lasts from 10 to 29 days (November January), and 13 to 20 days (March, May). The head and thorax of the bug is then almost black, with a light marking or shading along the margins of the head and down the centre of the thorax. The abdomen is considerably darker than in the second instar and is marked with a regular pattern of yellowish or whitish spots, with three somewhat conspicuous markings down

the centre of the abdomen. Eyes dark reddish, legs, antennae and beak, brownish black, length $3/16$ th inch.

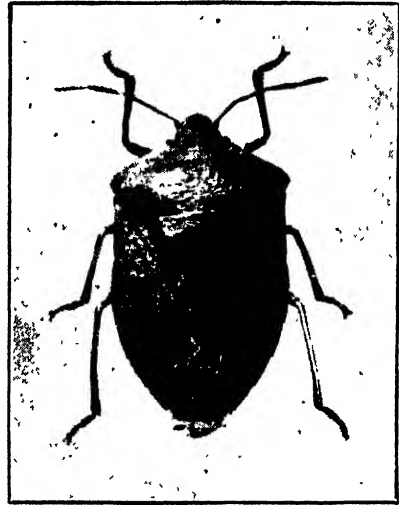
Fourth instar.—This follows the third moult and covers a period of 11 to 33 days (November, January), and 14 to 36 days (March, May). This stage varies considerably in colour and pattern. The light forms have the head and thorax pale green, with black markings, abdomen slightly darker than head and thorax, with a pattern of yellowish or whitish markings. The centre of the abdomen has three distinct dark areas, legs brownish.

PLATE IV.

PLATE III.



Fourth instar Bug with wing buds showing (Original.) Enlarged 3 times.



Adult or Imago Stage. (Original.) Enlarged 3 times.

The dark form. Head black with two distinct yellow markings at the side. Thorax black with orange-coloured marks along the side. Abdomen dark red or brown, central markings black, rest of abdomen marked with numerous yellowish spots. Antennae black, legs brownish black, length $1/4$ inch.

Fifth instar.—This follows the fourth moult and occupies 22 to 38 days (November, January), and 32 to 38 days (March, May). Like the fourth instar there is considerable variation in colour and markings.

In the light form the head, thorax, and wing buds are pale green with black margin and other black markings. Abdomen yellowish green, darker towards the centre with red areas surrounded with black. Numerous other spots of a yellowish colour, lateral margin of abdomen bordered with black. Antennae green, with terminal segments black, legs greenish brown. Eyes dark brown.

The dark form has head and thorax black. Margins of head and thorax with orange markings. Abdomen dark brown to almost black, with numerous white spots and pinkish margin. Antennae and legs almost black. Length about $2/5$ th inch.

Adult or Imago.—This appears after the fifth moult. The adult female is oblong in form, measuring on the average about $5/8$ th inch long. The male rarely exceeds half inch. The colour is a striking green on the dorsal or top side and a paler green on the ventral or under side. The head, thorax, and

elytra or wing covers, are densely covered with minute punctures. The antennae is pale green, merging into brown on the last two segments. The eyes are dark green. The legs are pale green. The rostrum or beak is light brownish in colour and is carried in a folded back position under the head and thorax. There is a total dissimilarity in colour and markings between the various pre-winged or nymphal stages of this bug. This great variation has led many growers astray in that they do not connect the varied coloured nymphs with the adult green bugs.

LIFE HISTORY.

Period.			Period.		
November, December, January,			March, April, May.		
1932.			1933.		
Egg stage	..	10--12 days	Egg stage	..	5--7 days
First instar	..	4--5 "	First instar	..	2--3 "
Second instar	..	6--24 "	Second instar	..	11--20 "
Third instar	..	10--29 "	Third instar	..	13--20 "
Fourth instar	..	11--33 "	Fourth instar	..	14--36 "
Fifth instar	..	22--38 "	Fifth instar	..	32--34 "
<hr/>			<hr/>		
77--120 days			53--141 days		
<hr/>			<hr/>		

Average period to adult, 98 days. Average period to adult, 97 days.

As the season advanced the periods in the life cycle shortened, and as the summer declined, the periods lengthened.

The figures for the fifth stadium were rather scanty as only four bugs reached the adult stage in the November-January period and two in the March-May period. However, the fifth stage in these six instances was fairly consistent, being 22, 34, 38, 34, 32, 27.

If the life history in the field corresponds roughly to that obtaining under laboratory conditions, there would not be more than three generations a year, as development during the winter months is considerably retarded.

Copulation.—The earliest record of copulation during the period of the investigation 1932-33 was July 29th, 1932. Several pairs of bugs had been taken in the field on July 25th and two of these pairs were observed in copulation on July 29th. On August 3rd and September 5th copulation was observed in the field. On September 5th, 18 pairs of bugs in copulation were taken in the field and placed in observation boxes and copulation took place during the following six weeks. These acts were separated by periods of from three to 20 days.

OVERWINTERING OF THE BUG.

Adults of *Nezara viridula* are found hiding away under bark, amongst garden litter or in other suitable sheltered positions during winter (May to August). The majority of these bugs turn a greenish chocolate brown and appear to be very sluggish and give the impression of completely hibernating until the following spring. It is our opinion, however, that these dark bugs gradually die off and that it is those which retain their green colour and come out at intervals of fine weather during the winter and feed, that carry through from autumn to

spring. Fifth instar bugs are also observed to be active during the fine winter days, and no doubt carry through to the spring, when the final moult takes place and they appear as early spring adults.

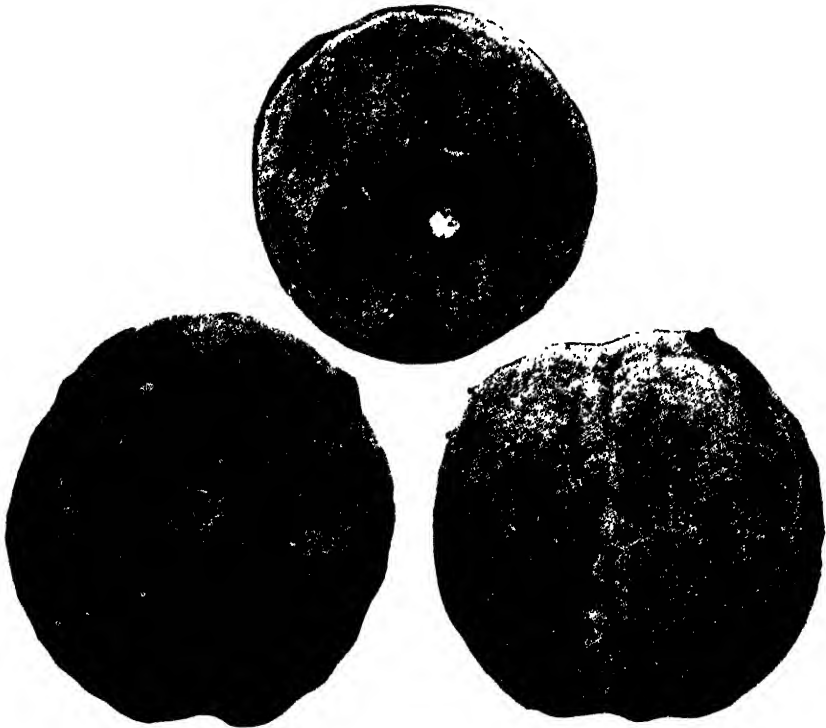
These nymphs when captured during the winter and fed in the laboratory, moult and become adults, showing that development is still proceeding during winter. Finally, experiments conducted in feeding the adult bugs during winter proved that those whose food was cut off die much more rapidly than those which are fed. The bugs which survive the winter appear to definitely require food during this period.

The adult bugs are capable of living for some months, and during this period may lay several rafts of eggs.

CHARACTER OF INJURY.

This bug is termed a Haustellate insect, or in common parlance, a sap sucker. The rostrum or beak is inserted into the foliage or fruit and the liquid juices sucked out. The effect on the foliage is to cause the leaves and young shoots to turn yellow, flag, and finally wither up.

PLATE V.



Peaches showing bugs in the act of sucking and the distorted effect produced.
(Whitmarsh.)

In the case of fruit, the portions which have been punctured appear to die, whilst the unpunctured portions continue to grow, and thus is produced the hard dry unevennesses so commonly found in fruit attacked. Fruit when cut, clearly shows the dead patches under the skin.

The keeping qualities and flavour of fruit are destroyed. Fruits badly damaged by this bug are rendered entirely unsaleable, and, even if only slightly affected, they become second grade.

Beans are a favourite host plant, the beans being sucked dry and rendered tough and useless. Tomato fruits exhibit a mottled appearance, and have in the flesh many dry and tough patches.

Many other fruits, vegetables and flowers are severely damaged by this bug.

PLATE VI.



Peaches cut open, depicting the damage caused by the bug to the tissue of the fruit
(Whitmarsh.)

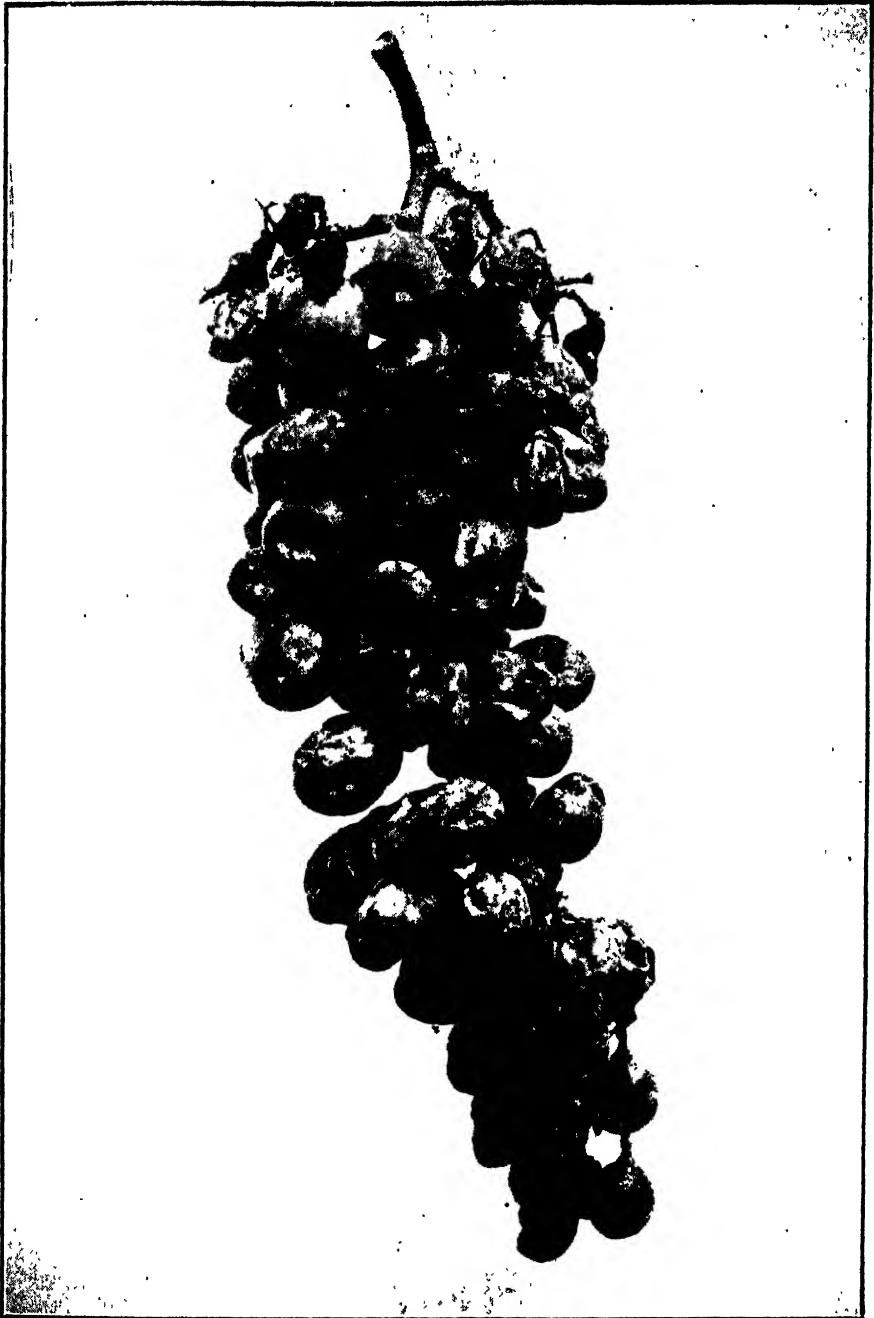
CONTROL MEASURES.

Knowing that the eggs of this bug are laid in clusters on the under side of the foliage of the plant attacked, much good can be accomplished by picking off these egg masses and destroying them.

The habit of the young bugs when first emerged and up to the first moult, is to live and feed gregariously, so that they will always be found in clusters near or on the eggs from which they have hatched. They are more readily destroyed whilst in the pre-winged stage; therefore, every effort should be made to destroy them whilst they are sensitive to contact sprays. Once the adult winged stage is reached, it is a most difficult pest to destroy.

The bug is purely a sap sucker. It is, therefore, useless to apply poison dusts and sprays as for caterpillars. The only way a plant bug can be destroyed is by fumigation or contact spray. In general, fumigation is out of the question, owing to the cost of materials and labour involved.

PLATE VII.



White grapes depicting the shrivelling and drying-up of the fruit as the result of bug attack. (Original.)

In the use of contact sprays, it is very important to see that the pump used has sufficient power behind it to ensure that the spray is forced into the breathing spiracles, the mere wetting of the bugs with the spraying material is not sufficient.

To meet the difficulty occasioned by the presence of this pest, the grower must provide a suitable spraying outfit. Whatever style of pump is used, it should be fitted with three or four feet of extension pipe, a curved elbow, and a good nozzle.

The following sprays can be used with good effect:—

Phenyle 1 quart, washing soda 3 lbs., soap 2 lbs., water 40 gallons. Shred the soap and dissolve by boiling in two gallons water, add the other ingredients, and break down to the required strength by the addition of the balance of water.

Another useful formula is the following:—Soft soap or Sunlight soap 4 lbs., turpentine $1\frac{1}{2}$ pints, water 20 gallons. Dissolve the soap in four gallons of boiling water, remove from fire and allow to cool off, but not get cold. Add the turps, stirring thoroughly, and make up to 20 gallons with water.

Carbolic Lifebuoy soap spray:—One cake of this soap to the gallon of water. Shred the soap and dissolve by boiling. Apply warm.

Concentrated clensel, a proprietary spray, used at a strength of one part to 60 parts water is effective, especially against the pre-winged stages.

Pysect, a ready to use pyrethrum spray, at one part to 100 parts water is also good.

Katakilla proprietary spray, at a strength of one packet to $2\frac{1}{2}$ gallons of water, will destroy the bugs.

An effective spray is made with the following:— $1\frac{1}{2}$ cakes U.C.S. carbolic soap, half pint kerosene, and four gallons of water. Shred the soap and dissolve by boiling in two gallons of water. Remove from the fire and add the kerosene and thoroughly emulsify. Make up to four gallons with hot water.

Any spray containing a carbolic content should not be used on foliage or fruit about to be consumed, as it will impart an objectionable flavour.

Pyrethrum dust alone or pyrethrum dust mixed with an equal quantity of $2\frac{1}{2}$ per cent. nicotine dust, applied with a dust gun, will destroy many of the bugs and also act for a time as a deterrent. The dust should be liberally applied to the infested plants and to any bugs which may fall to the ground.

All tomatoes should be grown on trellises or stakes. If allowed to grow on the ground, it is impossible to get in contact with the bugs, when using contact dusts or sprays.

Farm sanitation is an important factor in the control of this pest. All tomato, bean, or other plants which have ceased to be of value, should be pulled up and destroyed by fire. Keep down all weeds and litter. Avoid the practice of allowing the headlands and fence alignments to become overgrown with weeds, or covered with rubbish, as such conditions make excellent breeding grounds for the bug.

Keep a sharp lookout for the bug during the winter and early spring and destroy any found, as these are the progenitors of the future summer and autumn swarms.

Destroy all egg masses which are generally found on the backs of the leaves of the plants attacked. The hope of artificial control lies in the destruction of the pre-adult stages. Once the bug has become adult and winged, it is most difficult to kill with sprays or dusts.

Bantam fowls allowed to roam in an infested crop, will help very materially to keep the pest in check.

BIOLOGICAL CONTROL.

As the Green Bug has assumed the role of a major pest and has proved so difficult of artificial control, efforts have been made to introduce and establish effective insect parasites. Through the good offices of Professor J. R. Watson, Head of the Department of Entomology, University of Florida, several shipments of a Tachinid Fly, *Trichopoda pennipes*, which is parasitic on the adult bug, have been forwarded during the past two years. Unfortunately all shipments to date have failed, no parasites having arrived alive at this end. We are deeply grateful to Professor Watson and those who have assisted him in making these efforts, and are still hopeful that some successful means of transportation will yet be evolved.

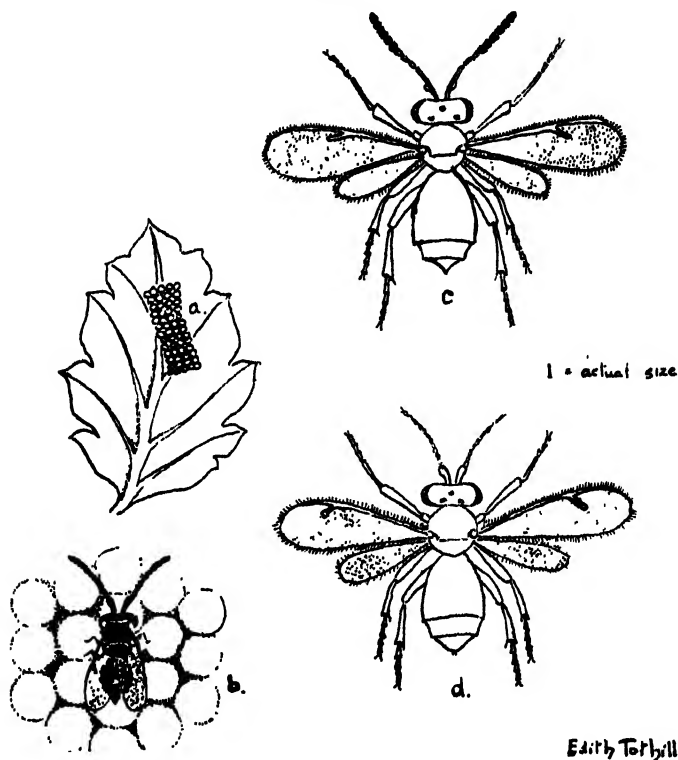
To Dr. H. Preisner, Chief Entomologist, Ministry of Agriculture, Cairo, Egypt, we are greatly indebted for the successful forwarding of an egg parasite of the Green Bug, *Microphanurus megacephalus*, Ashmead. This tiny parasite belongs to a group of wasps known as the Proctotrypidae. These are egg parasites, their larvae living inside the eggs of other insects, particularly bugs, butterflies, moths and flies. Various species are found in many parts of the world and several native species have been recorded from Australia. We have been successful in rearing from the Egyptian stock large numbers of this wasp locally for distribution. The methods of breeding and distributing employed, are for growers interested to collect and forward the bug egg masses to the Entomological laboratory. The eggs, as before stated, are laid on the backs of the leaves, which, to be of use for the breeding of the parasite, should be creamy yellow in colour. If they have turned pink, they are too advanced and should be destroyed. The eggs are submitted to the wasps for four to five days. When definitely showing signs of turning dark, which indicates that they have been successfully parasitised, they are removed from the breeding cages. These eggs are gummed to small strips of calico and mailed to the growers with instructions to stick or pin them to the backs of leaves of infested plants. *It is essential* to see that these parasitised rafts of eggs are not exposed to the direct rays or the hot sun.

The wasps hatch out in due course and seek out fresh rafts or masses of bug eggs to lay into, and thus the work of balancing nature is carried on. It is yet too early to make any definite statement as to whether this parasite will successfully negotiate our winter.

The body length of this wasp is 1/12th inch. The male has a black, non-metallic body, legs and antennae brown, wings clear with very reduced venation and covered with short cilia or fine hairs. Fore and hind wings with longer cilia around edges. The antennae are elbowed and moniliform. The female resembles the male in general, but has clavate or clubbed antennae, the enlarged segments being almost black. The life cycle from egg to adult takes from nine to ten days.

For the very excellent drawings of this parasite, I am indebted to Miss Edith Tothill, of Perth. In the breeding and distribution of the wasp I have been assisted by Mr. C. Jenkins, of this branch.

PLATE VIII.



Microphanurus
megacephalus, Ashmead

- (a) Egg raft (natural size)
(b) Parasite attacking eggs (enlarged)
(c) Female (multiplied by 13)
(d) Male " " "

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THE FEEDING OF CONCENTRATES TO HIGH PRODUCING COWS UNDER TEST IS PROFITABLE.

(G. K. BARON-HAY, Superintendent of Dairying, and
L. C. SNOOK, Agricultural Adviser.

One frequently hears the statement made that the high yields of pure bred cows under official Herd Recording conditions are obtained at an uneconomical cost, and that the dairy farmer could not afford to feed concentrates as is the custom to cows under test.

From this statement, generally accepted as an axiom, it is but a short step to maintain that "the records of cows obtained under Herd Recording conditions are not a guide to the commercial dairy farmer wishing to purchase bulls with production ancestry, but may be a snare and a delusion."

It is interesting, therefore, to study the costs of feeding three cows which recently have completed a high yield under Pure Breed Recording conditions, especially as the three main dairy breeds are represented, the cows being:—

	Breed.	Date of Birth.	Owner.
"Banyule Silvermine 55th,, (25473) ... Jersey	Aug. 2nd, 1928 ...	Sabina Vale Stud Farm
"Koojan Bonnie Elizabeth" (1899) ... Guernsey	Mar. 23rd, 1927 ...	A. W. Padbury
"Telyarup Duchess 1st" (2504) ... A.I. Shorthorn...	...	Dec. 9th, 1928 ...	A. E. Grant

Two of the above cows are owned by breeders whose properties are situated in dry districts, namely, Mr. A. W. Padbury, at Koojan, average rainfall 18.51 inches, and Mr. A. E. Grant, near Geraldton, average rainfall 19.19 inches. The cost of feeding in low rainfall areas is higher than in the South-West of the State, but, even with this handicap, profitable returns are obtained.

On each monthly visit of the Official Recorder, a note is made of the concentrates and roughages being fed; the pasture also is inspected.

The cost of the total ration has been computed, using the prices listed in Schedule A. These prices are considered to be a fair average.

Details of the monthly rations and monthly productions of these three cows are shown in Schedule A-D. at the end of this article.

TABLE 1. VALUE OF BUTTER FAT AT 9d. PER POUND COMPARED WITH COST OF FEEDING.

Name of Cow.	Breed.	Butter Fat Production.	Value of Butter Fat at 9d. per lb.	Value of Skim Milk at 1d. per gallon.	Value of Butter Fat plus Skim Milk.	Total Cost of Feeding	Profit over Cost of Feeding.
Banyule Silvermine 55, Wonnerup	Jersey	lbs. 680.5	£ s. d. 24 15 0	£ s. d. 2 5 4	£ s. d. 27 0 4	£ s. d. 11 13 1	£ s. d. 15 7 3
Koojan Bonnie Elizabeth. Koojan	Guernsey	571.0	21 3 0	1 14 6	22 17 6	14 13 0	8 4 6
Telyarup Duchess 1st, Geraldton	A.I.S. ...	522.8	19 12 1	2 11 6	22 3 7	14 0 0	8 3 7

Table 1 above shows the saving that is made in cost of feed through good pasture being available for seven months of the year at Wonnerup, as against approximately only four months at Koojan and Geraldton. It is also significant to notice that all these cows received ample supplies of silage.

The average cost of feed per cow in the Herd Recording Scheme during 1932-33 was £9 per cow, the production being 308 lbs. of butter fat. The three cows here considered produced an average of 585 lbs. of butter fat, or 277 lbs. of butter fat more than the average Pure Bred Cow. In other words, for an extra feed cost of £4 8s. 8d. the value of butter fat produced was increased by £10 7s. 9d. It is apparent that with high producing cows, money spent on fodder is not wasted.



Banyule Silvermine 55th (25473).

Owned by Sabina Vale Stud Farm, Wonerup.

Highest producing cow in the Senior Four-year-old Class, standard 330 lbs. butter fat. Produced 10,887 lbs. milk, 660.5 lbs. butter fat.

The production of these three cows from the whole milk point of view is also illuminating, and is shown in Table 2.

TABLE 2.—SHOWING VALUE OF WHOLE MILK AT 1/- PER GALLON COMPARED WITH COST OF FEEDING.

Cows.	Breed.	Production of Milk.	Value of Milk at 1/- per Gallon.	Total Cost of Feed.	Profit over Cost of Feeding.
Banyule Silvermine 55th ...	Jersey ...	lbs. 10,887	£ s. d. 54 8 0	£ s. d. 11 13 1	£ s. d. 42 14 11
Koojan Bonnie Elizabeth ...	Guernsey ...	9,253	46 5 0	14 13 0	31 12 0
Telyarup Duchess 1st ...	A.I. Shorthorn	13,772	68 17 0	14 0 0	54 17 0

A perusal of Table 2 above shows clearly the high profit over cost of feed with such cows, where milk is being vended at 1s. per gallon, the average profit per cow being £42 14s. 11d. as against an average profit of £10 11s. 6d. per cow by the sale of butter fat.

It is obvious, therefore, at present prices that the producer of butter fat must of necessity feed his cows on more economical lines than producers of

whole milk at 1s. per gallon. This fact is shown clearly in the following Table 3:—

TABLE 3.—RELATIVE FEED COST OF PRODUCTION OF MILK AND BUTTER FAT.

Cows.	Milk.		Butter Fat.	
	Feed Cost per Gallon.	Average Market Price per Gallon.	Feed Cost per lb.	Market Price per lb.
Banyule Silvermine 55th	2·57d.	10d.	4·24d.	8d.
Koojan Bonnie Elizabeth	3·80d.	10d.	6·10d.	8d.
Tolyarup Duchess 1st	2·44d.	10d.	6·42d.	8d.
Average	2·85d.	10d.	5·51d.	8d.

It will be noticed that no credit has been given for the value of the calf. Calves from such productive cows are exceedingly valuable, and constitute an important source of revenue to the breeder. It is here shown that these cows were not "forced" to produce uneconomically merely to boost the sales of progeny. On a butter fat basis, these cows have paid for their food and provided an average margin of £13 8s. from which to deduct labour and interest charges.

SCHEDULE "A."

PRICES USED IN ESTIMATING COST OF RATIONS FED.

	£	s.	d.	
Bran	5	10	0	per ton
Pollard	6	0	0	"
Crushed Oats	0	1	9	per bushel (40 lb)
Linseed Meal	0	14	6	per 100 lb.
Chaff	4	0	0	per ton
Silage	1	0	0	"
Grazing	0	1	6	per week
Grazing on cultivated crop	0	2	6	per week

SCHEDULE "B"

BANYULE SILVERMINE 55TH (25473)

Monthly Production and Food Consumption.

Month.	Milk.	Butter-fat.	Bran.	Linseed.	Crushed Oats.	Chaff.	Silage.	Pasture
	lbs.	lbs.	lbs.	lbs.	lbs.			
June	1,455	93·90	..	..	180	..	..	Clover and green oats.
July	1,320	88·65	..	..	180	300	..	Good mixed—some grazing oats.
August	1,200	83·40	..	..	180	..	..	Mixed.
September	1,125	59·28	90	30	180	..	..	Mixed.
October	1,170	62·55	90	30	180	..	..	Mostly drooping flower clover.
November	1,245	69·27	90	30	180	..	..	do. do.
December	1,170	67·98	90	30	180	300	..	Mostly clover drying off.
January	1,080	66·72	90	60	180	300	..	Dry drooping flower clover.
February	1,122	68·80	90	66	198	330	..	Dry natural—some whole maize.
Total	10,887	660·55	549	246	1,038	1,230	..	

SCHEDULE "C."

KOOJAN BONNIE ELIZABETH.

Monthly Production and Food Consumption.

Mo th.	lbs. Milk.	lbs. Butter fat.	lbs. Bran.	lbs. Linseed.	lbs. Chaff.	lbs. Silage.	lbs. Pollard.	Crushed Oats.	Pasture.
June	1,170	66-06	90	45	60	600	...	...	Natural grass.
July	1,110	62-22	120	60	300	...	...	...	do.
August	1,140	66-03	150	45	360	...	...	...	do.
September	1,140	69-96	120	45	360	...	60	...	Green oats.
October	1,110	70-59	90	30	240	...	30	...	do.
November	1,080	69-60	150	45	240	...	...	...	Oats.
December	900	58-14	150	60	360	...	...	...	Dry oats.
January	795	58-13	150	60	360	...	...	...	Dry natural grass
February	808	55-24	132	33	...	900	...	60	Dry stubble
Total	9,253	570-97	1,152	423	...	1,590	90	60	.

SCHEDULE "D."

TELYARUP DUCHESS 18T.

Monthly Production and Food Consumption.

Month.	lbs. Milk.	lbs. Butter- fat.	lbs. Concen- trate Mixture.	lbs. Chaff.	lbs. Silage.	lbs. Meadow Hay.	Pasture.
April	1,440	53-31	300	240	450	...	...
May	1,380	52-47	330	240	...	300	Short mixed natural.
June	1,320	52-66	360	240	...	300	do. do.
July	1,470	66-00	360	180	...	...	do. do.
August	1,800	65-49	240	180	...	...	Fair but short natural pasture.
September	1,725	60-90	240	180	...	...	Fair mixed natural pasture.
October	1,740	61-56	150	180	...	...	Fairly good mixed natural pasture.
November	1,515	59-88	180	240	...	...	Fairly good mixed—dried off.
December	1,402	51-55	264	198	...	...	Fair mixed.
Total	13,772	522-82	2,304	1,938	450	600	...

SOME STUDIES IN CHURN SANITATION.

Paper read before the Second Annual Conference of the Dairy Factory
Managers and Secretaries' Association, February 16, 1934.

By M. CULLITY, B.Sc. (Agric.).

This subject has been chosen as one that for two reasons is of particular importance to all factory operatives.

1. Churn cleansing is portion of the daily routine.

2. While it has long been accepted that the equipment with which dairy products come in contact, is an important source of bacterial contamination in these substances resulting in loss of keeping quality, churns have been definitely demonstrated by a large number of workers to be the principal source of recon-

tamination of butters. Recontamination undoes all the good work which may have gone before. The care exercised by the farmer in the production of his cream and its storage and the work of cream grading is nullified if by other factors in the treatment of the butter, it is found that good keeping quality is not achieved.

It is not proposed to criticise methods in use in this State or to state a method of cleansing that will be fool-proof, but it is intended to treat of work carried out by investigators in other parts of the world and their results. This work, though not carried out in our own factories, is none the less valuable and the essential principles are not altered.

The churn, because of its construction, is a particularly difficult piece of equipment to keep clean and has been shown repeatedly to be a prime factor in reseeded the cream with large numbers of micro-organisms. This reseeded or recontamination is particularly important, as it occurs after pasteurisation and, therefore, the organisms introduced have unchecked liberty to carry out their particular function.

It is not suggested that all the organisms which reach the butter from contact with equipment in the factory are sure to cause rapid deterioration. It is generally found that the bulk of the recontaminating organisms are of the bacillus type which may produce only slow changes, but others, even of the same type, can produce serious deterioration rapidly. Other types, however, are capable of producing rapid and extensive changes. The position is actually that nearly all the organisms are capable of creating harmful change. Under favourable conditions of storage, however, the change may not be noticed, but when allowed to come under conditions of temperature and storage, such as are found in retailing establishments, the condition of the butter may alter rapidly.

The fact that churns are usually constructed of wood, which is more difficult than metal to keep in a sanitary condition, renders the problem difficult. The surface is not so smooth and all sorts of depressions and minor cracks can shield organisms. The wood also tends to absorb moisture containing quantities of milk solids, placing a ready food supply available to the bacteria.

The combined churn and worker is naturally a still more difficult problem than the older types because of the inaccessibility of certain parts and the fact that working parts are present (bearings, etc.) from which it is impossible to prevent milk solids and fat accumulating. The greater the amount of wear in these parts, the greater the amount of material gathered. The severe strains set up during churning and, particularly during working in this type of churn, also tend to loosen joints, etc., allowing the formation of extra contaminating foci and also result in an cbb and flow of the material gathered in the out of the way places.

Various investigations have been carried out and will be discussed under headings according to the method of treatment.

1. Hot water and alkalies, etc.
2. Germicides.
3. Boiling water and steam.
4. Lime.
5. Various.

Lund reported that neither treatment with hot chloride of lime nor with scalding hot water was successful in removing contamination, but found that when hot alkali solution followed by hot freshly prepared milk of lime was used,

the yeast count was greatly reduced. He also pointed out that where heavy recontamination by moulds takes place, that still heavier recontamination by bacteria occurs also. James stated that hot water plus washing powder was not effective. In further trials, using germicides in addition to heat treatment, more successful results were obtained. He stated "increase in temperature and in period of exposure greatly favoured the chemical treatment and temperature of medium, fulness of churn and length of exposure were apparently the cardinal factors in churn cleaning." This worker drew attention to the difficulty of sterilising churns because the sterilising medium does not come into contact with all the organisms which may be in inaccessible places. He showed that the organisms obtained from churns could be killed at temperatures and in solutions of germicides as used in practice. This was done by treating suspensions of organisms obtained from churns with ordinary dilutions of germicides, etc. The fact that organisms can lodge in inaccessible places in churns has probably been forcibly demonstrated to all of us from time to time, e.g., between the staves of the barrel or in the rolls of the workers, or in the glands, and it is the difficulty of getting at these accumulations which renders the work of cleansing the churn particularly difficult.

The effect of using a germicide in addition to hot water has been the subject of investigation by a number of workers. Lund and James have been already mentioned. Gregory found a commercial germicide effective, as did also Shutt Morrison, Macy and Combs, however, found sodium hypo-chlorite and choramine T ineffective. Hammer and Olsen found that the use of chlorine on churns treated with hot water resulted in reductions of the numbers of organisms. In general, it would appear that results from the use of these preparations depend largely on the previous treatment of the churn—the concentration of the chlorine compound, the temperature, and the time of exposure. The data seems very indefinite and no sure conclusion can be drawn from it.

The use of boiling water prior to the treatment with chlorine seems, to my mind, to be a dominating factor, particularly in view of the work of Haglund, Barthel and Waller, who studied four churn-cleaning methods—(1) hot water, (2) hot water and a coating of lime, (3) hot milk of lime, (4) water heated to boiling with steam. The last method was found most effective, as butter free from yeast and mould could be made from it. Butters manufactured after this treatment also showed superior keeping quality. This would indicate that the numbers of bacteria present were also reduced.

In Danish experiments it was found that only water heated to boiling with steam was effective in destroying harmful bacteria, while according to Morrison, Macy and Combs, "Sufficient exposures to hot water and flowing steam were the most satisfactory methods for the treatment of churns." Results from the work of these men are also of interest as they illustrate the extreme difficulty of sterilising beneath the actual surface of the wood. They found that when a churn was exposed to boiling water, it required a period of $1\frac{1}{2}$ hours for heat to penetrate the wood to a depth of $1\frac{1}{2}$ inches and raise the temperature to 144 deg. F." Hence the great necessity of prolonging the heat treatment in cleansing, not only the length of time of washing, but the actual temperature of the washing medium must be kept up, even if it is necessary to stop the churn and to introduce the steam hose. Hammer and Olsen found that churns regularly treated with hot water commonly contained relatively few organisms. They also found that the bacteria found in churns were largely types resistant to ordinary degrees of heat.

The use of lime is fairly widespread, so the results of work carried out on this substance will be of interest.

Gregory found that with overnight treatment with a suspension of lime, after hot water treatment gave unsatisfactory results, the only advantage of the lime was that it improved the odour of the churn. Ruehle advocated frequent sterilisation and advocated soaking for three days in milk of lime followed by several rinsings of hot water for new churns or old ones which had stood idle for some time. Hood and White (Canada) suggested that contamination is not serious if liming be practised regularly. Shutt found that treatment with boiling lime solution for five minutes, then diluting this to the capacity of the churn and holding for three days was not so successful in reducing contamination, as when the churn was treated with boiling lime for 30 minutes before diluting. This system of liming the churn was first recommended by Lund and is strongly advocated by Hood and White for the treatment of badly contaminated churns.

Mention may be made of two other substances that were investigated. Shutt carried out trials with sulphuric acid but found the results not satisfactory. "Salting the churn" was found by Caulter to be effective in reducing the yeast and mould content of butter, but Hammer and Olsen found that the total number of organisms as indicated by the Agar Disc method was not appreciably reduced. Morrison, Macy and Combs found also in their heat and germicidal treatments, that it was considerably easier to eliminate moulds than it was bacteria.

This would indicate that yeast and mould counts of butter are principally useful when positive results are obtained, for it has been demonstrated frequently that high yeast and mould counts go hand in hand with higher bacterial contamination. If it is easier to destroy the moulds, etc., than the bacteria, it is reasonable to conclude that when the low mould counts are obtained it does not indicate definitely that bacterial contamination is also low.

Occasionally arguments are used against certain methods of cleansing because of their effect on the surface of the wood. Both heat and the chlorine treatments have a softening effect. However, this is a false argument to accept if it means the institution of an ineffective cleansing system, as the action of the bacteria and their products will soon show a very injurious effect on the wood. The inclusion of a regular lime treatment would do much to counteract the softening influence of heat by hardening the surface of the churn and by filling the pores.

Advocacy of one particular system of cleansing is not intended, but emphasis must be made on the outstanding factors in the work referred to. The actual method or routine of doing the work does not matter so long as the principles underlying sterilisation are complied with. These are, in essence, heat and a reasonable period of exposure. Occasionally the thoroughness with which churn washing is carried out leaves much to be desired. The method used by Hammer and Olsen in their studies on the micro-organisms in churns is simple and may be quoted as an example, which, if applied regularly, would keep churns in a satisfactory condition.

The general procedure used on the churns was as follows:—

1. The milk solids were rinsed from the churn by adding water at a temperature of from 100deg. to 120deg. F., revolving the churn for several minutes and then draining it.

2. The churn was filled one-third to one-half full of water at 170deg. to 180deg. F., soda ash added at the rate of about 1 pound per 100 gallons of water, the churn revolved in high gear for about 15 minutes and drained.
3. The churn was filled about one-half full of water at not less than 180 deg. F. and preferably at 200deg. F. or higher, and revolved in high gear for about 15 to 20 minutes. It was then drained thoroughly and turned so that the door opening was about two-thirds of the way up; in this position the churn dried rapidly. After the churn was dry a frame covered with screen was placed in the door opening. In some of the latter trials muslin was used over the screen as a protection against contamination from the air. About once a week slaked lime (free from sand, gravel, etc.) was added to the last water at the rate of about 1 pound per 100 gallons of water.
4. Before use the churn was rinsed by filling it one-third to one-half full of water at about 50deg. F., revolving in high gear for 5 minutes and then draining.

They concluded, as mentioned previously, that churns regularly treated in this manner contained relatively few organisms.

It will be noticed that the two aspects referred to above are taken care of. Water, heated as near to boiling temperature as it is possible to get it is the final washing, and this is applied after a really hot treatment with soda ash. Actually the period of exposure to high temperatures was about half an hour. This would allow the heat to penetrate to some distance under the surface of the wood. It is suggested that, when heating water in a churn by way of a steam hose, a thermometer should be used, as it often happens that water is thought to be near boiling temperature when actually it is still a long way from it.

Reference can be made in conclusion to the Agar discs method of studying the degree of contamination from factory equipment. Photographs and actual discs have been demonstrated on the department exhibit obtained from our own factories. The system of studying the contamination in this way is such that it can be applied in the factory and the results watched without recourse to detailed laboratory work. The discs obtained appeal to the factory man, as an actual print or cast of the surface being studied is taken. The melted agar is poured direct on the surface and, when sufficiently solid, can be transferred to a sterilised petri dish.

A drawback to the method, however, is that it cannot give any indication of the condition of inaccessible places in the churn. The only way of studying the condition of the churn as a whole is by the rinse method from which the results can be worked out only in the laboratory and stated in figures—so many per cubic centimetre. The number would vary according to the amount of the water used and its initial bacterial content. The agar disc count is expressed as so many per square centimetre of surface, and this allows direct comparisons between churn and churn to be made in a way that can be appreciated by all.

The added advantage of demonstrating to the eye the actual degree of contamination is particularly valuable, and one which appeals to the factory worker.

IMPROVEMENT OF PASPALUM AND SUB-CLOVER PASTURES.

T. C. DUNNE, Merchants' Research Officer, Muresk Agricultural College,
and

H. K. GIBSONE, Assistant to Officer in Charge of Irrigation.

The old irrigated pastures of the Harvey area have been in the main, dominantly paspalum in the summer and sub-clover in the winter and spring. In general these pastures have two defects, viz.:-

1. The rather low protein content of the paspalum.
2. The low production during the winter months.

1. *Low protein content of paspalum.*

For economical milk production, dairy stock need a reasonably high percentage of protein in the pasture. The protein content of most pasture species decreases as the plants develop. Under conditions of adequate moisture and warmth, paspalum makes abundant growth. Very often it is found that the number of stock which can be carried on the pasture throughout the year are unable to cope with the summer flush of feed. The paspalum grows long and there is a rapid decrease in the protein content.

The protein content of grasses may be greatly increased by the application of nitrogenous fertilisers. Except in special cases, however, high expenditure is not profitable with the existing price levels for dairy products.

Good management of the sward is profitable. This includes—

- (a) Rotational grazing of paddocks, whereby the milking cows may be always on young fresh growth;
- (b) use of the mowing machine whenever the stock are unable to cope with the rate of growth of the pasture;
- (c) regular spreading of droppings whereby a cheap form of nitrogen is distributed and rank ungrazed patches are avoided.

In addition to good management, the inclusion in the sward of a species having a normally high protein content will greatly improve the nutritive value of the pasture and will, in fact, tend to provide a "balanced" feed. It has recently been demonstrated moreover, that a non-legume such as a grass, growing in association with a vigorous legume, may actually absorb nitrogen compounds secreted by the root nodules of the legume and thus increase its protein content. The obvious species for improvement is a clover making good summer growth. This method of improvement should be permanent.

2. *Low production during early winter.*

There is a period in early winter when paspalum is dormant and sub-clover makes little growth. Usually heavy hand feeding of stock is necessary. This situation may be eased to some extent by the provision of pastures consisting of winter growing species or by the introduction of a winter growing species into the existing pasture.

An attempt was therefore made to introduce white clover and perennial rye grass into an old paspalum pasture. The purpose of the white clover was to improve the protein content of the pasture and of the rye grass to provide some early winter feed.

The best seed is always the most profitable for permanent pasture. In this trial seed of New Zealand certified mother strain perennial rye grass and of New Zealand certified white clover was used.

The site selected for the experiment was an old paspalum and sub-clover pasture which had been ploughed in June, 1931, for purposes of renovation. By

the autumn of 1932, the paspalum had made fair recovery but the growth of couch grass had been stimulated considerably. However, the growth had not, at that time, been sufficient to completely cover the soil.

The surface soil was loosened with a spike harrow. One half of the paddock was left as control and, on May 15, 1932, the other half was seeded at the following rates, viz. :—

White clover	4 lb. per acre.
Perennial rye grass	20 lb. per acre.

A good germination of rye grass and a fair germination of white clover were effected. By August, the grass had made good growth but the clover plants were still small. The pasture was cut for hay in November, by which time a number of seed heads of rye grass had been formed and the white clover was beginning to spread. Thereafter the pasture was almost continuously grazed and provided good winter feed from both the rye grass and the clover. The white clover spread rapidly and by June, 1933, had covered most of the sown area.

A fertiliser mixture of 4:1 super and sulphate of ammonia was applied at the rate of 2 cwt. per acre in the autumn and $1\frac{1}{2}$ cwt. per acre in the spring. During the summer months the plot received four monthly waterings commencing in December, 1932. In addition, the pasture received winter and summer harrowing.

The paddock has since been subjected to almost continuous grazing. The white clover has continued to spread and make good growth. The growth of the rye grass has been satisfactory, but a true estimate of its value should be obtained by further observation during the coming winter.

By no means the least satisfactory aspect of the experiment is the increased palatability of the pasture as a whole. On the control area, there are present large patches of paspalum and dry couch grass which are always left by the stock. On the other hand, the portion containing white clover has been grazed very closely and evenly and the presence of couch grass can be detected only by close observation. Both the couch grass and the paspalum have a particularly healthy dark green appearance, presumably owing to their association with the clover.

Hitherto, in this pasture, the prevalence and spread of a water weed (*Heleocharis capitata*), growing mostly in poorly drained patches and in the furrows, has caused some uneasiness. During the summer this plant grew to a height of about six inches and seeded. It had a yellow appearance and was ungrazed by stock. With the establishment of white clover, the plant has apparently derived benefit from the supply of nitrogen secreted by the root nodules and has developed a healthy green appearance. Presumably owing to an increase in palatability, it is now kept very short by the stock. Grazing of this nature, if not totally eradicating the weed, will at least prevent its further spread.

The results of the experiment to date indicate that the carrying capacity, nutritive value and palatability of a paspalum and sub-clover pasture may be considerably improved by the introduction of a good strain of white clover. It is considered, from the results of this and other experiments, that all seed mixtures being sown under irrigation conditions for permanent pasture should contain at least 2 lb. per acre of New Zealand certified white clover. At present the success and value of perennial rye grass under these conditions are less definite. A better estimate can be made in the light of further data.

For the purposes of establishment, ploughing may not be necessary. Any type of cultivation which gives sufficient bare ground for the germinating seedlings to obtain a good root hold would be satisfactory. The sowing should be done in the autumn to avoid undue early competition from the paspalum.

The rate of seeding in the experiment was high. White clover at the rate of 2 lb. per acre and perennial rye grass at the rate of 10 lb. per acre should give satisfactory results.

In the experiment, seed of *Phalaris tuberosa* at the rate of 3 lb. per acre was also sown but was a complete failure. This is understandable from the results of other experiments which have shown that this grass can be successfully established only when the competition from other species, in the first year of its growth, is reduced to a minimum.

VIRUS DISEASES OF PLANTS.

WITH PARTICULAR REFERENCE TO THE SPOTTED OR BRONZY WILT DISEASE OF TOMATOES.

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The following is a general account of that group of plant diseases brought about by the presence in the sap of parasites so small as to be quite invisible, even with the highest powers of the microscope. How the presence of these invisible, filter-passing organisms is proved is discussed, and some of their most interesting properties indicated. Artificial and natural methods of infection and the role of insect carriers, such as aphids and thrips, in the spread of virus diseases are referred to. It is indicated that the virus responsible for the spotted wilt disease of tomatoes has recently become a serious menace to the successful growth of many flower-garden plants.

DEFINITION OF DISEASE.

Before one can appreciate the special importance and significance of those diseases of plants belonging to the Virus group, it is necessary to have a clear-cut idea of just what is meant by the term "disease" itself.

Disease may be defined as any condition of a plant, quite irrespective of its cause, which tends to reduce its vigour or to shorten its life, or to detract in any way from the quantity or quality of the yield which might reasonably be expected under ideal conditions. In a shorter and more simple manner we may say that disease is any condition of a plant which falls short of perfect health. Perfect health results only from the inter-action of perfect heredity and ideal environment, two requirements which are, of course, rarely found separately, and even less commonly in combination.

CAUSES OF PLANT DISEASE.

Plant diseases may be brought about by living or non-living causes. Those diseases which are caused by attack on the plant by some other living organism or parasite are known as *parasitic* diseases. Those which are caused in any other way are called *non-parasitic*, *physiological*, or *physiogenic*.

NON-PARASITIC DISEASES.

Some examples of non-parasitic diseases, which can only be mentioned in passing, are the "Grey Speck" disease of wheat and oats, which occurs in this State on those soils where there is, in certain seasons, a deficiency of available manganese in the soil; the die-back, gumming, or "Exanthema" disease of orange trees, which



Fig. 1. —Tobacco leaf affected with Tobacco Mosaic. Note the dark green blistered areas (healthy) in strong contrast to the larger yellowish or light green areas (diseased) forming the greater part of the area of the leaf.

After L. F. Mandelstam, from "Tobacco Diseases," in "Tobacco growing in Queensland," Dept. Agriculture and Stock, Queensland, 1933.

appears to be brought about by a deficiency of copper and which can be prevented or cured by the application of powdered bluestone to the soil or by routine spraying with Bordeaux Mixture; "Water Core" disease of apples which is brought about by the exposure of the fruit to unduly high temperatures during heat waves; "Blotchy Cork" disease of apples which is brought about by the leaves drawing water back from the fruits during periods characterised by very hot drying winds; true "Bitter Pit" of apples which is caused by the mere fact of picking the fruit of susceptible varieties after it has begun to ripen but before it is sufficiently mature; "Streak" or "Stripe" disease of sweet peas or tomatoes which is induced by over-liberal manuring with nitrogenous manures and insufficient use of sulphate of potash; "Yellow Berry" disease of wheat, which is due to a deficiency of available nitrogen in the soil; and "Sour Sap" of apricots and other stone fruits, which often results from inadequate drainage.

One of the best known examples of a non-parasitic disease in this State is the burning back of the edges of the leaves of loquat or plane trees, grape vines, etc., during periods when the root system is unable to absorb water from the soil as fast as it is being transpired ("evaporated") from the leaves by the hot drying winds of our very severe summer. A further very clear cut example of a non-parasitic disease is frost injury on wheat, which was very much in evidence on wheat heads, leaves and stems in this State during 1932. (See "Journal of Agriculture" for June, 1933, pp. 286-291, or Leaflet 379.)

PARASITIC DISEASES.

Turning to the parasitic diseases we find that these are caused by living organisms such as bacteria, fungi, slime moulds, eelworms, insects, or even certain flowering plants, such as broom-race which occurs very commonly in the metropolitan area, living on the roots of cape weed, clover, and so on; dodder, which attacks lucerne and clover, etc.; mistletoe, which attacks the native eucalypts; or the much admired Christmas tree (*Nyctsia floribunda*), which is quite unable to support itself by its own unaided energies on the nourishment obtainable by other plants from air and soil, but lives as a parasite on the roots of practically any kinds of plants growing within its reach.

VISIBLE AS DISTINCT FROM INVISIBLE PARASITES.

Now even though many of these parasites such as bacteria, fungi, slime moulds, etc., are quite invisible to the naked eye, they are very easy to see, and in fact appear quite enormous, under the magnification of a high powered modern microscope. All the groups of parasites so far mentioned are, therefore, lumped together by scientists under the general heading of visible parasites, inasmuch as by one means or another they can be readily seen.

VIRUS DISEASES OR DISEASES CAUSED BY INVISIBLE PARASITES.

Since 1892, however, when Ivanowski concentrated his attention on a previously neglected disease known as tobacco mosaic, we have come to recognise a very large group of plant diseases as being caused by parasites (or causal agents of some kind) of such minute size as to be quite invisible even with the highest powers of the microscope. At the present time there is very much more work being done throughout the world on plant diseases of this type than any other, and, during the past 30 years, an enormous literature on the subject has been built up; yet no one has ever seen the cause of any one of these particular diseases or has the faintest substantiated idea of what it looks like. Diseases which are brought about by parasites or causal agents of this type are known as Virus diseases.

Some readers may be inclined to suggest that the magnification of our microscopes should be increased if these organisms cannot be seen with our present ones. Such a suggestion leads nowhere, however, inasmuch as the ability to see



Fig. 2.—Healthy "Delaware" Potato Plant. Notice great vigour of growth, abundance of soft foliage, and entire absence of mottling, wrinkling, or rolling of the leaflets. Compare with Figures 3, 5 and 6.

After W. M. Carne, this Journal, June, 1927.

objects with the microscope depends on the objects looked at being of sufficient size to interfere with the passage of light through the lenses and so throw an image on an illuminated background, but it has been shown that the viruses

are smaller than the wave length of light, so that they do not interfere with its passage and consequently remain, and may forever remain with the present type of microscope, invisible.



Fig. 3.—Potato plant with “crinkly mosaic.” Photographed to same scale as Fig. 2. Notice mottling and crinkling of many of the leaflets, especially those near the top of the plant. Such plants give considerably lower yields than healthy plants grown under identical conditions, and they act as centres of infection to the healthy plants round about. The disease is spread by means of infected tubers, aphids, and perhaps also by other kinds of sucking insects. Symptoms of the disease show up very plainly in the winter months, but may be entirely obscured during the summer on account of the high temperatures. All such plants should be removed from the “stud plots” and destroyed.

After W. M. Carne, this Journal, June, 1927.

As further indicating the exceedingly small size of these viruses, it may be added that a characteristic feature is their ability to pass through porcelain Chamberlain and Berkfeld filters of such a fine degree of porosity as to completely filter out of the solution any known visible parasites.

How is it then, some will ask, if scientists cannot see these organisms and cannot filter them out of a liquid in which they occur, that they can be certain there is any parasite present in a plant suffering from one of these mysterious virus diseases? The explanation is simple. If one takes a perfectly healthy tobacco plant, grinds it up in a meat mincer, squeezes out the sap with a mortar and pestle, filters the sap through a porcelain filter candle to remove all visible matter, then injects this filtered sap into another healthy tobacco plant and sets the latter aside to await developments, one may wait forever without the second healthy tobacco plant being any the worse for its experience. But, if the experiment is now repeated with one modification only, viz., that a tobacco plant affected with tobacco mosaic disease is crushed up and its filtered sap injected into a healthy one, it will be found, after waiting for about fourteen (14) days, that the inoculated tobacco plant, with almost dramatic suddenness, has developed unmistakable symptoms of tobacco mosaic, and this process may be repeated from the second to a third plant, and so on an infinite number of times, with always the same result.

A further surprising fact is that if the sap of a mosaic tobacco plant is diluted with 10,000 times its own volume of sterile water, it still remains infectious. So infectious, indeed, is this particular virus disease that if a needle be lightly rubbed along the surface of a tobacco leaf affected with mosaic and then be similarly lightly rubbed along the leaf of a healthy plant the disease may be readily transmitted, and yet the lightness of rubbing may have been such as to cause no obvious wounding or injury of any kind to either plant. Another curious feature of most plant viruses is that they are remarkably resistant to poisonous substances such as ether, chloroform, toluene, carbon-bisulphide, carbon tetrachloride, etc., which are very rapidly fatal to many known visible parasites. The virus of tobacco mosaic will resist putrefaction of the sap for fifteen (15) months and will live in dried tobacco leaves indefinitely.

SIGNIFICANCE OF THE TERM "MOSAIC" DISEASE.

The tobacco mosaic disease is readily spread about a field on the fingers of the farm workers. Affected plants become more or less stunted and yellowish, have smaller leaves than normal, and, in any leaves developing after the inoculation took place, irregularly shaped elevated blisters of intensely green tissue occur scattered through the general yellow background of the bulk of the leaf. The alternation of these dark green (healthy) and yellowish (diseased) patches causes a pattern somewhat suggestive of a tiled mosaic floor, from which fancied resemblance the term "mosaic disease" has been derived.

The natural method of transmission of the tobacco mosaic virus is by means of sucking insects known as aphids.

VIRUS DISEASES OF ANIMALS, MAN, AND PLANTS.

Virus diseases are not confined to plants, but are found also in animals, including human beings. Well known virus diseases of the lower animals are:—Hog Cholera (Swine Fever); Rabies of Dogs; Dog Distemper; Foot and Mouth Disease of Cattle; Rinderpest of Cattle; and Jaundice of Silk Worms (8).

In man occur:—Infantile Paralysis; Smallpox; Mumps; Measles; Hydrophobia and Warts (8).

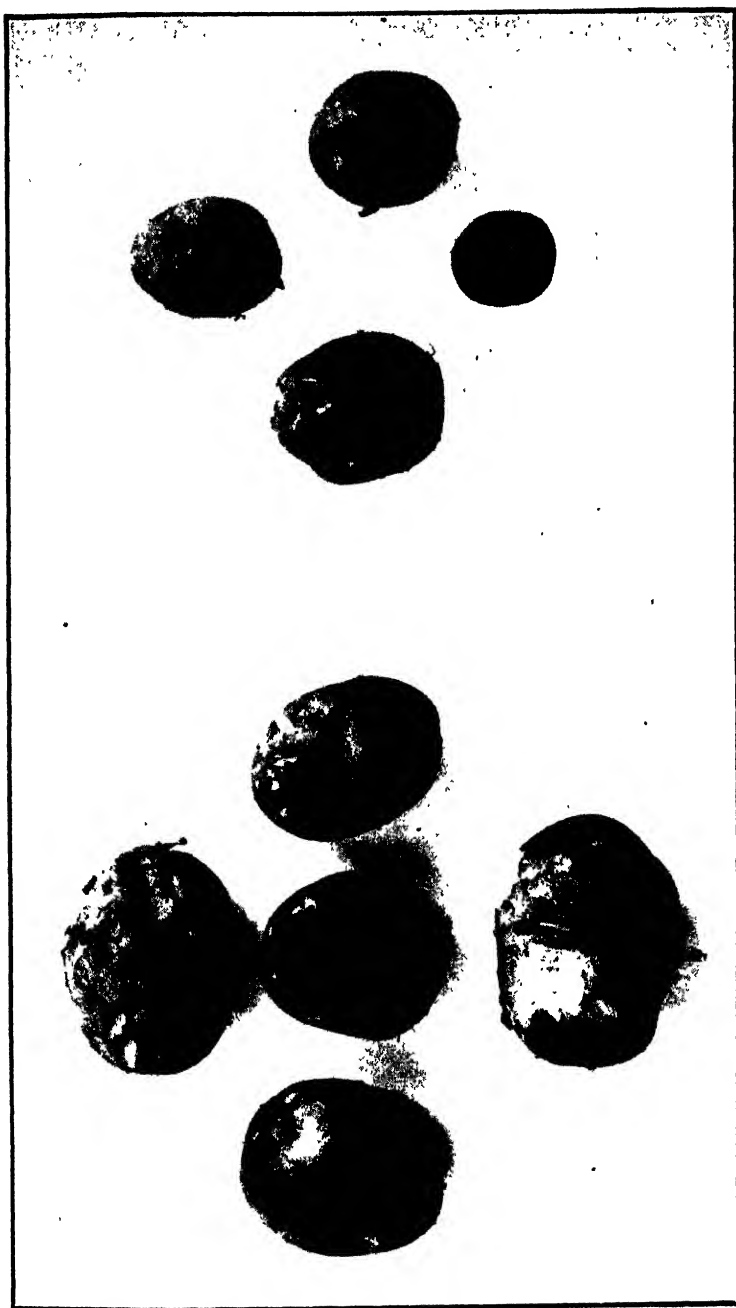


Fig. 4.—A. Potatoes from healthy plant in Fig. 2.

Fig. 4.—B. Potatoes from ‘crinkly mosaic’ plant in Fig. 3.

After W. M. Carne, *this Journal*, June, 1927.

In plants the most outstanding are:—Peach Yellows; Little Peach; Peach Rosette; Curly Top of sugar beets; Aster Yellows; the various Mosaic diseases of tobacco, tomato and potato; and in Australia—Bunchy-top of bananas (3); Spotted or Bronzy Wilt of tomato (1, 5, 6); Bullet or Woodiness of passion fruit (4); tomato, tobacco, and potato mosaic; and potato "Leaf Roll."

Even the bacteria are not free from virus diseases but may be attacked and destroyed by invisible agents called *bacteriophage* (8).



Fig. 5.—Advanced "Leaf Roll" of Potato. Affected plants are usually smaller than healthy ones, and they often have an unusually large number of branches, each, or some of which, bear a number of brittle, thickened, yellowish, sometimes purple-tinted, rolled leaflets. The whole of an affected plant often has a stiff, pale, yellowish appearance, and the rolled leaflets give out a characteristic rattle when the plants are shaken. "Leaf-roll" causes a much more serious reduction in yield than either "mild" or "crinkly mosaic." The disease is carried by aphids or infected tubers. It is not "masked" by high temperatures.

(Photo. N.S.W. Dept. Agric.).

"DEGENERATION" OR "RUNNING-OUT" OF POTATO VARIETIES.

The so-called "degeneration" or "running out" of potato varieties which has been known in agriculture for a very considerable period has comparatively recently been shown to be due to the gradual accumulation of virus diseases within the variety as time goes on, unless deliberate efforts are made to prevent it. The old practice was to introduce a new variety of potatoes raised from the true seed, as distinct from tubers, as soon as the yields of the old variety became so low as to render it unprofitable. This method was successful inasmuch as it so



Fig. 6.—Severe form of "rugose mosaic" on Bliss Triumph potato plants. Any plants showing such symptoms should be immediately destroyed.

After the photograph by B. F. Dana, in Hecald's "Manual of Plant Diseases."

happens that the dissemination of virus diseases by true seed is not usual. But it is now known that there is no reason why the same variety should not continue to yield heavy crops from now on for ever, provided that steps are taken to keep virus diseases in check by elimination of any diseased plants as soon as noticed and by the ruthless suppression of aphids and other insects by which they are naturally spread from plant to plant. The Certified Seed Scheme operating in this State aims to keep the seed potatoes as free as possible from virus diseases. (See "Journal of Agriculture" for June, 1930, pages 347-353, or Leaflet No. 305.)

TRANSMISSION OF VIRUS DISEASES BY SPECIFIC INSECTS.

While most virus diseases which are naturally transmitted by aphids are also readily transmissible from plant to plant by human inoculation, as explained earlier, those virus diseases which are naturally transmitted by means of other kinds of insects can often not be transmitted by human inoculation. Thus, "Curly Top of sugar beets" "Streak" disease of maize, and "Aster Yellows" are all transmitted by their own particular insect carriers or vectors—in these cases not aphids but leaf-hoppers, and in no other way, organic union by grafting or budding excepted.

While working at the Waite Institute in Adelaide in 1927, the writer discovered that the "Spotted Wilt" disease of tomatoes is transmitted by a species of thrips—*Thrips tabaci* (5)—this being the first case of a virus disease being de-



Fig. 7.—Two "Burwood Prize" tomato plants artificially infected with "Spotted Wilt" by placing on each of them five larval thrips taken from naturally infected tomato plants. The two large plants were uninfected "controls" on to which no thrips were placed. All the plants were the same size (being only several inches high) when the experiment commenced with the use of the thrips five weeks previously. The "control" and "experimental" plants were grown alternately as indicated above and received identical treatment in every way, except for the placing of infective thrips on to the "experimental" plants (occupying positions 1 and 3 reading from the left). The photograph was taken about three weeks after the first appearance of symptoms and when the affected plants had commenced to make a little new growth (which often happens when the plants are grown under experimental conditions and are carefully tended).

After H. A. Pittman, *Journal of the C.S.I.R.*, November, 1927.

nitely proved transmissible by thrips. Subsequent work by Messrs. Samuel and Bald indicated that the black carnation thrips—*Frankliniella insularis*, is also a carrier of this disease (1, 6). All attempts to artificially transmit this disease by means of inoculation with infected sap failed until these two workers developed a special technique, as a result of which it is now possible to produce the disease by artificial inoculation with a very high degree of certainty (1).

As indicative of the great economic losses which may be caused by a virus disease, it may be stated that following on the outbreak of the "Bunchy-top Disease of bananas" in northern New South Wales, 90 per cent. of the banana plants were rendered useless between 1922 and 1927. In southern Queensland in the Currumbin district the disease proved so disastrous that the railway freights fell from £20,000 per annum in 1922 to a paltry £500 in 1925 and the weight of bananas sent from the station fell from 4,400 to 110 tons (3).

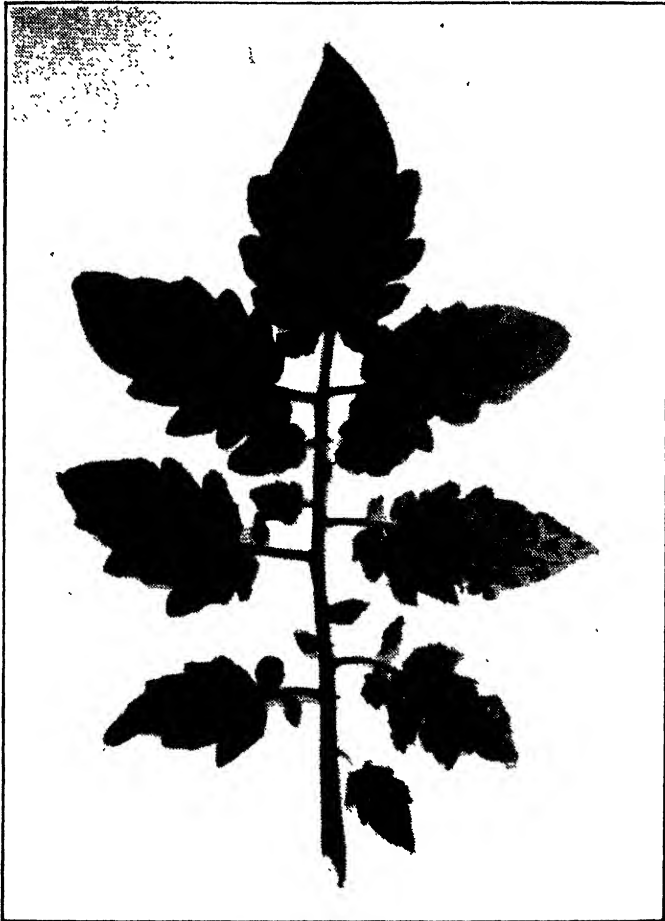


Fig. 8.—Bronze markings of "Spotted" or "Bronzy Wilt" on a leaf of a "Golden Queen" tomato plant from the field.

After G. Samuel, J. G. Bald, and H. A. Pittman, Bull. 44, C.S.I.R.

In Western Australia the most important virus disease at the present time is the "Spotted" or "Bronzy Wilt" disease of tomatoes. This disease annually wipes out hundreds of thousands of tomato plants in most of the Australian States, although it was quite unknown in Australia prior to 1915-1916, in which season it was first noticed in the vicinity of Melbourne (6).

SYMPTOMS OF SPOTTED OR BRONZY WILT OF TOMATOES.

Almost everyone who has tried to grow tomatoes in the neighbourhood of Perth will be only too familiar with the symptoms of this dread disease. Tomato plants which one night appear perfectly healthy may on the following morning show a very characteristic shining, spotted, or more generally diffuse bronziness or copper colour on the topmost surfaces of the topmost leaves. If the plant has been allowed to branch so as to form a number of separate stems, the youngest leaves at the top of each shoot may show these shining bronzy symptoms more or less simultaneously. The affected plants stop growing at the time of appear-

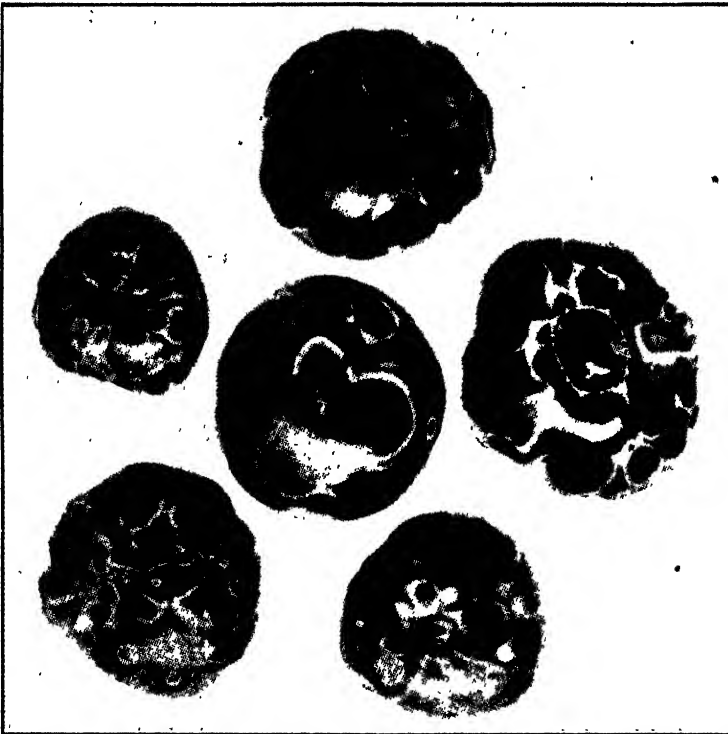


Fig. 9.—Yellowish markings on the ripe (red) fruit of "Early Dwarf Red" tomato plants which were affected with "Spotted Wilt." Such fruits have a very poor flavour and poor general quality.

After G. Samuel, J. G. Bald, and H. A. Pittman, Bull. 44, C.S.I.R.

ance of the bronzy markings and in the course of a week or so show up as badly stunted plants by contrast with any of their neighbours which may still be healthy. The rather pretty bronzy freshness of the original lesions only lasts for a very few days, after which the affected leaves during normal weather become very much shrivelled and dried up. Flowers present at the time of appearance of the symptoms fall off, long brown streaks may develop down the stems; any fruits present may develop red and yellow mottlings, or more rarely, bronzy rings, as they gradually ripen up. No more fruits will be formed and the quality of the mottled ones will be very inferior. Plants attacked when young usually

die outright, but older ones may struggle along unthrifflly for months after managing to survive the first drastic consequences of infection, never being of any further use to the grower from a commercial point of view.

MANY FLOWER-GARDEN PLANTS SUSCEPTIBLE TO SPOTTED WILT.

As indicated earlier, this disease is naturally transmitted from plant to plant by two species of thrips. Both these thrips occur commonly in many garden flowers and it has been shown recently by Bald and Samuel at the Waite Institute (1) that not only do the garden flowers harbour the thrips, but that many garden flower plants may actually become infected with the "Spotted Wilt" disease itself and serve to spread the disease to tomato plants in the vicinity. A number of the susceptible garden flower plants are winter growers, so that in this way the disease is carried through that portion of the year when the tomatoes are not being grown out-of-doors.

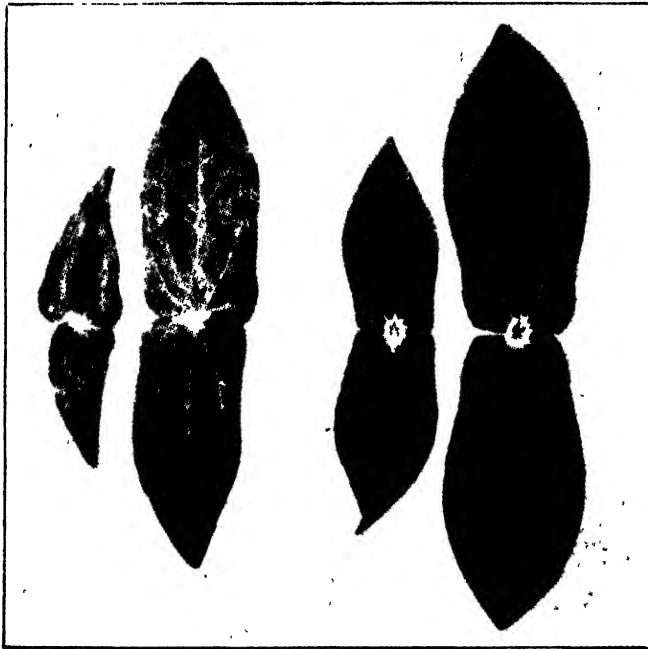


Fig. 10.—On left, two leaves of the garden Zinnia, *Zinnia elegans*, from a plant mechanically inoculated with tomato "Spotted Wilt" 29 days previously. Photographed 17 days after the appearance of symptoms. Leaves from "control" (healthy) plants on right.

After J. G. Bald and G. Samuel, Bull. 54, C.S.I.R.

Some of the garden flower plants found by experiments at the Waite Institute to be susceptible to the "Spotted Wilt" virus are:—schizanthus, aster, chrysanthemum, zinnia, iceland poppies, nasturtiums, petunia, and salpiglossis. Tobacco, cape gooseberries, egg plant, chilis, black night shade and apple of Sodom have also been infected (1).

In England, where the disease broke out in tomato glass houses some three years ago, the following additional plants have been found susceptible:—dahlia, cineraria, potato, lupins, and broad beans (2).

In Western Australia it has been impossible to carry out any investigations with virus diseases, as such investigations demand an insect-proof glasshouse, but symptomatic evidence indicates that the "Spotted Wilt" virus has for several years now played havoc with:—dahlias, especially seedlings, Iceland poppies, asters, *Calliopsis drummondii*, nasturtiums, ranunculi, anemones, and perennial scabious, while it has been less serious on petunias, yellow and ordinary cosmos, English marigolds, and columbines. During the spring of 1933 many beds of ranunculi and anemones in the metropolitan area were almost completely wiped out by the ravages of this disease. (The "evidence" for the statements made in this paragraph is "symptomatic" and "circumstantial," not experimental.)

The symptoms shown by garden flower plants affected with "Spotted Wilt" are not very similar to those of the tomato, and it is only the trained eye that can accurately diagnose the cause of the trouble as due to the Spotted Wilt virus in many cases. Common symptoms are a "clearing" of the green colour along or adjoining the veins, a faint bronzy or brassy hue on the uppermost surfaces of affected leaves, death and rotting of petiole (leaf-stalk) tissue, and the development of dead sunken patches on flower stalks. Iceland poppies, anemones, and ranunculi are rapidly killed or may linger and not produce any further normal flowers. The young leaves of dahlias are often reduced to little more than mid-ribs, while whitish hieroglyphical markings or more or less irregular whitish concentric circles may appear on older leaves. Flower buds of dahlias are blackened, while dahlia seedlings may be killed out in hundreds a few weeks after planting out into the flower beds. Dahlia plants grown from tubers do not suffer so seriously as seedlings, especially if they receive ideal treatment and are planted in soil containing a considerable amount of loam, rather than the almost pure sand characteristic of the metropolitan area. The basal leaves of dahlias affected with the Spotted Wilt virus show a very pronounced tendency to dry up in hot drying winds. Varieties with white or light-coloured flowers appear on the whole to be more seriously affected than those with red or other dark-coloured blooms.

THE CONTROL OF VIRUS DISEASES.

The problem of the control of virus diseases is one which obviously presents great difficulty, inasmuch as it is exceedingly difficult to exercise 100 per cent. control of insect carriers with any of the methods at present known to science, and it is obvious that only by complete eradication of these insect carriers, combined with the immediate destruction of all diseased plants, can we hope to successfully deal with the problem, unless resistant varieties are bred or some entirely new means are discovered for rendering the plants either tolerant or immune.

Tomato growers should avoid growing tomato plants near flower gardens and do everything possible to eradicate thrips by very frequent spraying with Black Leaf 40 and soap, kerosene emulsion, prepared white spraying oil or some similar contact insecticide. This should be commenced long before any disease appears. Weeds growing along the headlands which may harbour thrips should be destroyed.

All diseased plants should be pulled out and destroyed by burning or boiling as soon as noticed.

A variety grown in the Balcatta area, known variously as "Arbuckles" or "Richters" appears to be somewhat resistant, as does also the "Early Dwarf Red." The "Early Dwarf Red" is the most resistant variety so far grown in this State. On no account should "Dwarf Champion" be grown as this is one of the most easily susceptible. (It is, however, a great favourite with a number of seed merchants and nurserymen, for sale purposes, on account of the sturdy and attractive appearance of the plants in the seedling stage.)

Frequent overhead watering tends to check thrips, but, unfortunately, tends to encourage fungous diseases, so that the more frequently overhead watering is used the more care must be taken to prevent fungal diseases of the foliage by spraying with Bordeaux Mixture or the use of copper-containing dusts.

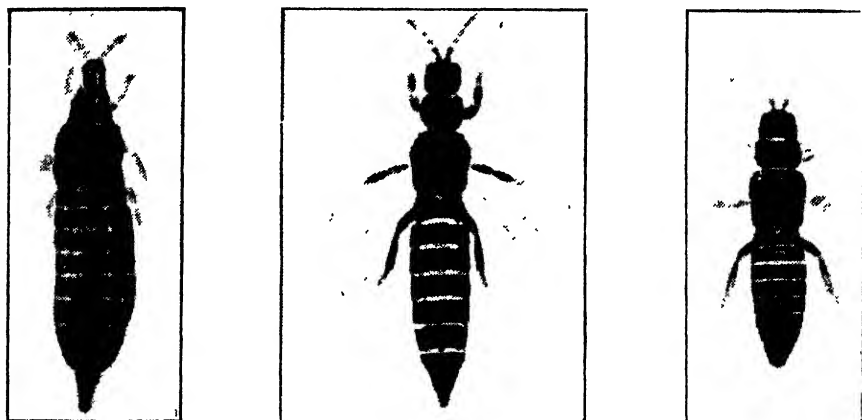


Fig. 11.—Left: Second stage larva of the "Black Carnation Thrips," *Frankliniella insularis*, one of the two thrips species which are responsible for the natural dissemination of the Spotted Wilt virus.

Middle: Adult female of same species.

Right: Adult male of same species.

The adults are winged but the wings are hardly obvious in the photographs. All much magnified. The actual size of these insects is about 1/25th inch. The other thrips species (*Thrips tabaci*) which transmit Spotted Wilt from diseased to healthy plants is much lighter in colour and less conspicuous than that pictured above.

After G. Samuel, J. G. Bald, and H. A. Pittman, Bull 44, C.S.I.R.

A plan which has a good deal to recommend it is to plant out two or three plants at transplanting time in a small triangle at each place where normally only one would be put. This allows of diseased plants being pulled out as soon as noticed without leaving a large number of unsightly gaps through the field. The disease does not spread at all rapidly by contact of diseased with healthy plants.

Tomatoes planted out after Christmas sometimes do not suffer to the same degree from "Spotted Wilt" as those planted earlier.

As indicating the very intimate relationship of the "Spotted Wilt" virus problem to flower gardens, the following facts may be cited. When the writer first went to the Waite Institute, in 1927, to investigate the "Spotted Wilt"

disease it soon became evident that the disease was more serious at the Institute than in many commercial plantings. The Waite experimental plots were immediately adjacent to and partly surrounded by flower gardens.

In 1931 the writer was responsible for the planting of about one-fifth of an acre of tobacco in the experimental plots of the Department of Agriculture in the grounds of Government House, Perth. The plots are separated by a



Fig. 12.—Two “Golden Queen” tomato plants seven weeks after they had first shown the symptoms of “Spotted Wilt,” together with two healthy “control” plants of the same age. The infected plants developed the disease as the result of the placing on each of them of three larval thrips taken from naturally infected tomato plants growing in the field. Symptoms first appeared about sixteen days after the thrips were placed on the plants.

All the plants were about four or five inches high when the thrips were placed on the “experimental” plants (positions 1 and 3 reading from the left). Following on the first severe check, the infected plants had made a certain amount of subsequent growth before the taking of the photograph. All the plants had been growing under identical conditions (except that no thrips had been placed on the “controls”), with the “experimental” and “control” plants alternately arranged, as in the photograph, from the commencement of the experiment.

After H. A. Pittman, Journal of the C.S.I.R., November, 1927.

wire-netting fence from the Government nursery, which always contains numerous beds of annual flowers in addition to shrubs, etc. About 35 per cent. of the tobacco plants were wiped out by a virus disease tentatively ascribed to infection with the “Spotted Wilt” of tomato virus. In 1933 tobacco plants were again planted in these plots, and again about 35 per cent. of the plants were killed by the virus disease, the incidence of the disease commencing in

each year shortly after transplanting the seedlings from the seed beds. G. Samuel and J. G. Bald, of the Waite Institute, have just published an article on the "Spotted Wilt" disease of tomato as it affects tobacco in South Australia (7), and their description exactly coincides with the Western Australian tobacco disease and removes all doubt as to the "Spotted Wilt" virus being responsible for the Western Australian disease, which is not known anywhere else in this State than in the neighbourhood of the Government nursery. Commercial tobacco fields in this State are usually planted in forest clearings and are rarely in close proximity to flower gardens. (No attempt was made to prevent thrips attacking the tobacco plants referred to above.)



Fig. 13. -Three "Golden Queen" tomato plants artificially infected with "Spotted Wilt" by means of larval thrips taken from naturally infected tomato plants growing in the field. Three larval thrips were used on each "experimental" plant (positions 1, 3, and 5 reading from left). These plants and their "controls" were from the same experiment as those in Fig. 12, but the photograph was taken ten weeks after symptoms first appeared on the "experimental" plants. Note that under glass-house conditions and with careful attention the infected plants have made some straggly abnormal growth after their first serious set-back. The diseased plants are without fruit, but some fruit has formed on the three healthy plants, as can be seen on close examination of the centre healthy plant, two trusses being fairly obvious; one near the middle left, and the other towards the top of the plant.

Photo. taken by Author at Waite Institute, 1927.

The problem of virus disease control is complicated by the very disturbing fact that whereas most fungal and bacterial diseases are confined fairly definitely to their own particular hosts and are usually quite unable to attack unrelated species or genera, the viruses show a very marked disinclination to "play fair"; *e.g.*, as just indicated, the "Spotted Wilt" virus may attack many plants quite unrelated to one another.

Two further complications occur. One is that the symptoms in some of these hosts may be quite dissimilar from those on other hosts, so that many persons would never suspect the identity of the causes in each case. The second of these further complications is that certain plant species may actually be heavily infected with viruses, but be quite unaffected in their growth so far as one can tell. These plants act as "masked carriers" in much the same way as certain people may be carriers for the diphtheria germ and yet not suffer from its presence themselves.

Nature has certainly arranged a difficult puzzle for solution in the virus disease problem. Possibly, however, there has been too much concentration on the virus and insufficient on the plant. The road leading to a complete knowledge of the virus appears to widen and become less clearly defined at every step, until eventually it threatens to cover a field as large as space itself. Perhaps the other road leading to a better knowledge of the plant and possible means of increasing its resistance or tolerance will eventually prove more fruitful of good results from the practical point of view. Only time will tell.

In conclusion readers interested in the pursuit of this or any other plant disease subject are advised they have only to communicate with the Plant Pathology Branch of the Department of Agriculture, when every endeavour will be made to assist them in their efforts to prevent nature voraciously consuming, on the one hand, per medium of plant diseases, what, on the other hand, she so lavishly makes available. Fortunately, science has discovered much more in regard to the control of many other types of plant diseases than is at present known about those belonging to the virus group.

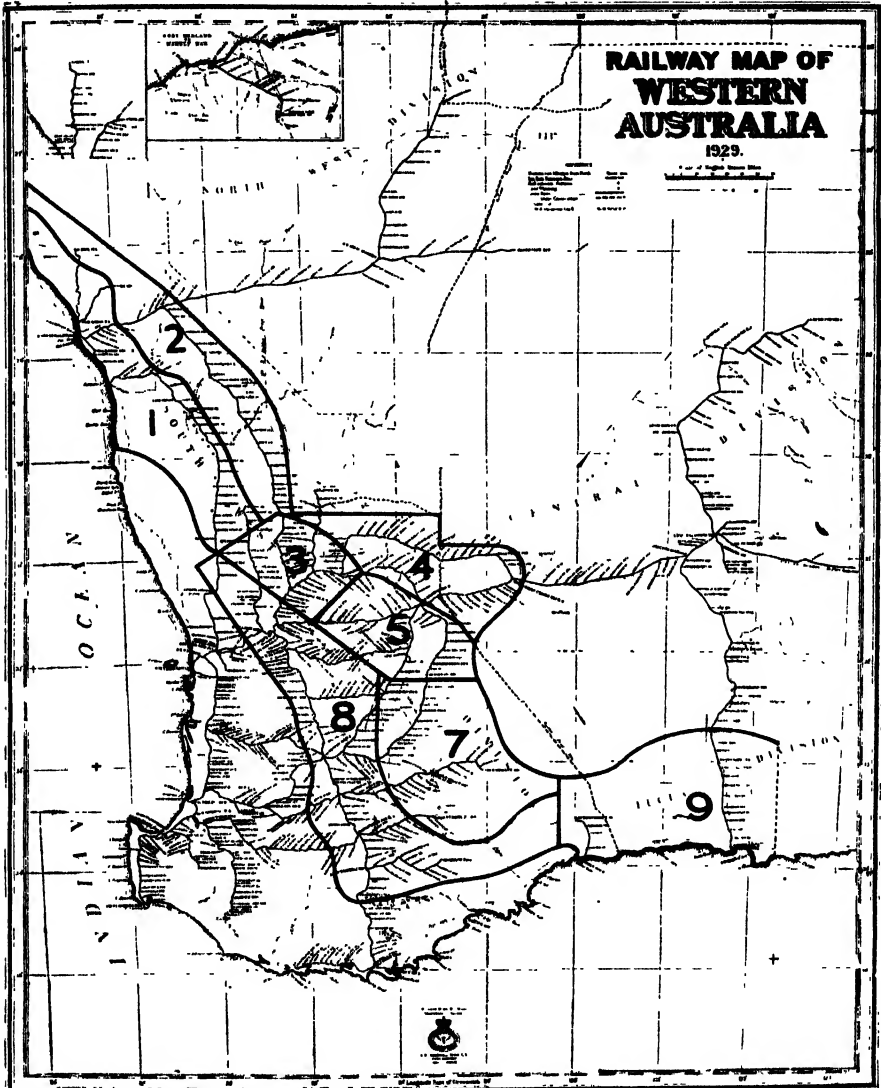
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ROYAL AND DISTRICT AGRICULTURAL SOCIETIES' 50-ACRE CROP COMPETITIONS, 1933.

I. THOMAS, Superintendent of Wheat Farms.

Entry for these competitions is made through the local Agricultural Societies. These societies organise their own district competitions, the first and second prize winners of which automatically become eligible to compete for the Royal Agricultural Society zone prize. Where the local society does not conduct a com-



Map showing boundaries of the respective zones.

petition, entry is accepted direct with the parent body, the Royal Agricultural Society. In this way no farmer, desirous of doing so, is prevented from participating.

As can be readily understood, there is considerable variation in rainfall, soil, etc., in a wheat belt so widely extended. For these reasons it has been subdivided into eight zones in such a manner that districts having similar interests and climatic conditions have been grouped together. In this way farmers may compete with each other more equitably. The accompanying map shows the eight zones referred to.

In each of these zones a championship prize of £10 and a second prize of £2 10s. are awarded.

In addition to these zone prizes the Royal Agricultural Society each year offers a special prize of £5 5s. to the competitor in any zone obtaining the highest calculated bushel yield per acre.

The conditions of the competitions require that the crop shall be grown on fallowed land, shall not be less than 50 acres in area of one variety, and shall be judged under the following scale of points:—

Yield	50 points.
Freedom from weeds	10 "
Freedom from disease	10 "
Freedom from admixture	15 "
Evenness of growth	15 "
<hr/>	
Total	100 points.

The system adopted has been to allot one point for each calculated bushel yield, which is determined not by estimation but upon that calculated from portions of the crop obtained from small areas taken systematically throughout the crop. These samples are then threshed and the grain weighed.

Since the inception of the Royal and District Crop Competitions the judges have been Departmental Officers attached to the Wheat Branch of the Department of Agriculture.

The detailed awards made are as follows:—

ZONE 1.

Judge: G. L. Throssell, Agricultural Adviser.

Three Springs Society, 5 competitors; Carnamah Society, 2 competitors;

Total, 7 competitors.

Three Springs Agricultural Society.

The rainfall recorded at Three Springs was as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Three Springs ...	11	3	36	15	306	658	194	258	67	110	1,602	38	21	1,721

The awards made are tabulated hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Carter, H. R. ...	Three Springs	Waratah ...	85	9	8	14	14	80
Lynch, P. J., Senator	do.	Bencubbin ...	31	8	7	14	12	72
Hobiton, J. K. (sen.)	do.	Merredin ...	28	8	9	13	18	71
Evans, R. J. ...	do.	Merredin ...	28	8	8	13	18	70
* Hobiton, J. K. (jun.)	do.	Merredin ...	26	8	8	13	18	68

Carnamah Agricultural Society.

The rainfalls recorded at Carnamah and Coorow were as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Coorow	6	46	20	26	226	447	172	279	77	102	1,303	18	25	1,453
Carnamah	10	3	46	25	344	628	201	366	76	98	1,713	41	34	1,872

The awards made are tabulated hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points.	Free- dom from Disease. 10 points.	Free- dom from Ad- mixture. 15 points.	Even- ness of Growth. 15 points.	Total. 100 points.
Bothe, B. D. ...	Coorow ...	Bencubbin ...	41	8	8	14	13	84
Forrester, J. K. ...	Carnamah ...	Bena ...	27	8	8	13	13	60

ZONE 2.

Judge: G. L. Throssell, Agricultural Adviser.

Only one entry, and that direct with the Royal Agricultural Society, was received for this zone.

The rainfall as recorded at Tenindewa was as follows:—

		Growing Period.											Nov.	Dec.	Total for year.
		Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sep.	Oct.	Total.			
Tenindewa	...	2	..	150	5	224	485	191	218	150	112	1,380	15	35	1,593

The awards made in connection with this entry are as set out below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points.	Free- dom from Disease. 10 points.	Free- dom from Ad- mixture. 15 points.	Even- ness of Growth. 15 points.	Total. 100 points.
Moore, Hon. T. ...	Indarra ...	Bencubbin ...	34	9	9	14	13	79

ZONE 3.

Judge: R. W. Prunster, Manager, Yilgarn Experiment Farm.

Dowerin Society, 4 competitors; Royal Agricultural Society, 3 competitors;
Total 7 competitors.

Dowerin Agricultural Society.

The rainfalls recorded at Minnivale and Dowerin are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Dowerin	16	84	5	14	168	285	162	240	44	110	1,009	81	10	1,219
Minnivale	12	55	12	12	202	260	161	207	69	152	1,051	134	59	1,335

The awards made are as follow:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Bear, H. E. ...	Minnivale ...	Bencubbin ...	31	8	9	14	14	76
Hughes, J. R. ...	do. ...	do. ...	35	8	9	10	13	75
Anderson, F. ...	Dowerin ...	Pusa ...	30	8	8	13	14	73
Williams, G. ...	Hindmarsh	Waratah ...	27	8	7	14	13	69

Royal Agricultural Society.

The rainfalls as recorded at Goomalling and Wongan Hills are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Goomalling ...	21	17	15	9	288	365	168	261	74	132	1,288	39	5	1,385
Wongan Hills ..	12	12	...	8	198	321	195	220	80	113	1,136	51	16	1,235

The awards are as set out below:—

Competitor.	Address.	Society.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Waterhouse, E. J.	Goomalling	Royal ...	Gluehub	37	7	8	13	13	78
Lane Bros. ...	Wongan Hills	do. ...	Nabawa...	28	9	9	14	14	74
Mt. Rupert Co.	do.	do. ...	Merredin	26	9	8	14	14	71

ZONE 4.

Judge: I. Thomas, Superintendent of Wheat Farms.

Mt. Marshall Society, 5 competitors; Mukinbudin-Lake Brown Society, 6 competitors; Southern Cross Society, 3 competitors; Nungarin-Eastern Districts Society, 9 competitors; Total, 23 competitors.

Mt. Marshall Agricultural Society.

The rainfalls as recorded at Bencubbin, Mt. Marshall and Gabbin are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Bencubbin ...	2	21	20	7	149	259	127	190	53	84	862	44	49	1,005
Mt. Marshall ...	6	18	18	14	155	286	151	197	55	88	932	78	34	1,100
Gabbin ...	4	16	39	24	166	293	135	188	61	97	940	87	54	1,164

The awards made are as set out hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Perry Bros. . .	Bencubbin ...	Gluyas Early	29	8	7	13	14	71
Hopwood, B. W. G.	do.	Bencubbin ...	26	9	8	14	13	70
Gilham, F. . .	Marshall	Gluyas Early	25	8	7	13	14	67
Collins, D. W. .	Rock Bencubbin ...	Nabawa ..	22	8	9	13	13	65
Flitcroft, W. . .	Gabbin ...	Bencubbin ...	22	7	8	13	13	63

Mukinbudin-Lake Brown Agricultural Society.

The rainfalls as recorded at the various centres are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total			
Mukinbudin . . .	9	36	36	3	105	233	112	156	69	78	753	84	...	921
Wilgoyne . . .	17	47	81	10	144	231	87	148	59	52	721	128	211	1,215
Mangowine .. .	19	33	11	38	96	230	111	161	94	69	791	67	49	1,008

The awards made, including those eligible for the local competition, but whose entry was received too late to participate in the main competition, are as hereunder:—

Competitor	Address	Variety.	Yield 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease 10 points	Free- dom from Ad- mixture 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Leyland, H. . .	Mukinbudin	Gluyas Early	25	9	8	13	14	69
*Hicks, C. T. . .	Lake Brown	Bencubbin ...	26	8	9	12	13	68
Connor, T., Senr. . .	Wilgoyne . .	Gluyas Early	24	9	7	14	13	67
Williams, T. A. . .	Mangowine .	Bencubbin	24	7	8	14	13	66
*Maddock, N. . .	Wilgoyne . .	Gluyas Early	21	9	8	14	13	65
Manuel, C. J. . .	Mukinbudin	do	22	7	7	14	14	64
Shadbolt, H. J . .	do.	do.	19	7	8	14	12	60
Harris, E. G. S . .	do	do	20	7	6	13	14	60
*Maddock, G . . .	Wilgoyne . .	Geeralyug ..	19	7	8	11	12	57

* Not eligible to compete for the Royal Agricultural Society's Zone Prize—Entry received too late.

Southern Cross Agricultural Society.

The rainfalls as recorded at the various centres are as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total			
Vilgarn Experiment Farm (Ghoolt) ...	20	...	108	39	211	245	120	193	40	50	859	42	70	1,138
Southern Cross ...	22	7	82	32	196	213	111	202	37	49	808	52	69	1,072

The awards made, in this case also including several who are ineligible for the main competition, are as hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Stevens, G. K. ...	Ghooll ...	Bencubbin ...	25	8	9	14	12	68
*Smith, P. J. ...	Turkey Hill ...	Noongaar ...	25	8	8	12	13	66
*Brockway, — ...	Corinthian ...	Gluyas Early ...	21	9	8	13	13	64
Davies, J. G. & F. ...	do.	Noongaar ...	20	7	9	13	13	62
*White, G. (Sen.) ...	Bullfinch ...	Gluyas Early ...	18	8	8	13	13	60
Dowdall, A. ...	Moorine Rock ...	do.	18	7	8	12	13	58
*Powell, C. R. ...	do.	do.	17	7	8	13	12	57

* Not eligible to compete for the Royal Agricultural Society's Zone Prize—Entry received too late.

Nungarin-Eastern Districts Agricultural Society.

The rainfalls as recorded at Kwelkan, Nungarin, Nukarni and Yelbeni:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Nungarin ...	11	4	65	9	119	275	165	157	56	64	836	77	40	1,051
Nukarni ...	9	...	22	20	125	196	154	195	65	99	834	31	45	961
Yelbeni ...	15	18	30	17	235	288	150	236	80	93	1,091	88	39	1,298

The awards made are as set out hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Oreagh Bros. ...	Kwelkan ...	Bencubbin ...	28	8	9	14	13	72
Jolly, H. P. ...	Nungarin ...	Nabawa ...	24	9	8	14	14	69
Evans, L. D. ...	Nukarni ...	Bencubbin ...	26	7	8	13	13	67
Jolly, J. ...	Nungarin ...	Geeralying ...	21	9	9	14	14	67
Williams, F. A. ...	do.	Bencubbin ...	24	7	8	14	13	66
Green, T. W. ...	do.	Nabawa ...	22	7	8	13	13	63
Gleeson, M. J. ...	Yelbeni ...	Bencubbin ...	22	6	7	14	12	61
Browne, — ...	Nukarni ...	Glucub ...	19	9	8	11	13	60
Vernon, G. J. ...	do.	Bencubbin ...	18	7	8	14	12	59

ZONE 5.

Judge: R. P. Roberts, Agricultural Adviser.

Merredin Society, 11 competitors; Bruce Rock Society, 11 competitors;

Total, 22 competitors.

Merredin Agricultural Society.

The rainfalls as recorded at the various centres are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Ulva ...	27	...	86	8	230	311	170	167	72	144	1,103	44	130	1,398
Nukarni ...	9	...	22	20	125	196	154	195	65	99	834	31	?	?
Beandee ...	10	...	62	16	165	248	82	123	59	89	766	23	86	963
Buracoppin ...	11	11	36	20	124	205	132	187	55	63	766	44	45	933
Walgoon (Kevin Farm) ...	...	...	33	23	115	262	180	238	55	49	879	?	?	?
Merredin ...	23	...	19	22	179	248	139	199	63	123	951	50	28	1,093

The awards made are as set out hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Teasdale, F. O. ...	Korbel ...	Beneubbln ...	31	8	8	14	14	75
Teasdale, H. W. ...	Ulva ...	Totadgin ...	31	7	9	12	14	73
Flockart, I. ...	Korbel ...	Geetalying ...	27	8	8	14	14	71
Maughan, T. G. & J. ...	Nukarni ...	Merredln ...	28	8	8	13	13	70
Kay, J. ...	Baandee ...	Glueclub ...	31	7	8	10	13	69
Reihelt, E. E. ...	Burraecoppin ...	Beneubbln ...	27	9	9	12	12	69
Barnett, L. T. C. ...	Walgooolan ...	Ghnyas Early ...	26	8	7	14	13	68
Smallacombe, T. H. ...	Merredln ...	Merredln ...	26	8	6	13	12	65
Horobin, E. A. & O. W. ...	Nangeenan ...	Beneubbln ...	22	8	8	14	10	62
Wahlsten, R. A. ...	Walgooolan ...	Cunberra ...	21	9	7	12	12	61
Cockram, H. W. ...	Nukarni ...	Beneubbln ...	22	7	8	13	11	61

Bruce Rock Agricultural Society.

The rainfalls as recorded at the several centres are as follow:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Yarding ...	39	...	13	29	256	224	144	128	48	220	1,020	18	74	1,202
Belka ...	21	2	34	18	189	228	134	163	102	125	941	42	34	1,092
Balakln ...	30	...	110	32	239	193	159	168	52	134	915	12	31	1,130
Bruce Rock ...	25	4	34	34	188	211	124	133	87	113	856	20	44	1,026

The awards made are as tabulated hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Farrall F. C. & Sons	Yarding	Glueclub	34	9	8	13	14	78
Teasdale Bros	Belka	Beneubbln	34	8	8	13	14	77
Smith, C. & Sons	Yarding	Glueclub	32	7	9	13	12	73
Buller & Black	Balakln	do.	31	8	8	13	12	72
Stevens, D.	Yarding	do.	31	7	8	12	13	72
Brown, R. H.	Bruce Rock	Nabawa	28	8	8	13	14	70
Brown, S.	do.	Glueclub	27	8	7	13	14	69
Schilling, C. E. & N. S.	do.	Beneubbln	28	8	8	13	10	67
Johnson, W. D.	do	Glueclub	27	8	7	12	12	66
Perkins, C. C.	Belka	Beneubbln	27	7	8	12	12	66
Pinlott, S. H.	Kwoyln	Sword	26	9	8	11	12	66

ZONE 7.

Judge: A. S. Wild, Agricultural Adviser.

Lake Grace Society, 7 competitors; Harrismith Society, 7 competitors; Karlgarin Society, 12 competitors; Kukerin Society, 12 competitors; Kulin Society, 8 competitors; Total, 46 competitors.

Lake Grace Agricultural Society.

The rainfalls as recorded at Lake Grace, Lake Biddy and Burngup are as follow:—

---	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Lake Grace ...	84	11	227	20	173	215	100	99	91	163	841	4	23	1,210
Lake Biddy ...	13	...	139	13	133	303	127	92	7	127	?	46	49	?
Burngup (Dulce) ...	77	6	152	21	222	314	139	131	93	169	1,068	51	125	1,500

The awards made are as set out below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Coad, J. ...	Lake Grace...	Bencubbin ...	35	9	9	14	13	80
Ourwood, W. ...	Lake Biddy	Gluyas Early	22	9	8	13	13	65
Carruthers, H. F. ...	Lake Grace...	Waratah ...	22	8	8	13	13	64
Blahop, H. J. ...	do. ...	do. ...	23	7	8	13	12	63
Carruthers, R. (Jun.) ...	do. ...	Glucub ...	24	8	7	11	13	63
Collinson & Fleay...	Burngup ...	Waratah ...	21	7	7	14	13	62
Tunney Bros. ...	Lake Grace...	Glucub ...	21	9	7	12	13	62

Harrismith Agricultural Society.

The rainfall as recorded at Tinkurrin is as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.		
Tinkurrin (Tovill) ...	130	47	132	36	240	302	159	121	113	138	1,073	5	1,423

The awards made are as shown hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
McDonald, W. G....	Tinkurrin ...	Bencubbin ...	32	8	9	14	13	76
Murray, A. ...	do. ...	do. ...	31	8	9	13	13	74
Norton, J. ...	do. ...	Nabawa ...	28	8	9	14	14	73
Parnell, F. G. ...	do. ...	Queen Fan ...	30	8	7	12	13	70
Atabury & Sons ...	Harrismith	Gluyas Early	23	7	8	13	13	64
Baker Bros. ...	do. ...	Free Gallipoli	24	8	7	12	12	63
Sukroo, W. P. ...	Tinkurrin ...	Nabawa ...	22	7	7	12	12	60

Karlgarin Agricultural Society.

The rainfalls as recorded at the several centres are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.		
Karlgarin, East ...	38	12	165	44	187	180	121	177	60	86	817	17	1,126
Hyden, South ...	54	5	182	51	202	145	135	160	59	130	831	42	1,176
North Hyden (Camel Peak)	87	...	41	48	194	158	153	168	64	168	906	?	?

The awards made are as shown hereunder:—

Competitor	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Grant, L. J. ...	Karlgarin ...	Bencubbin ...	32	9	8	14	14	77
Medcalf, C. W. ...	do. ...	do. ...	32	8	9	14	13	76
Marshall, H. J. ...	Hyden ...	do. ...	29	9	9	14	13	75
Biglin, E. J. ...	Karlgarin ...	Gluyas Early	32	8	8	13	13	74
James, S. W. ...	do. ...	Bencubbin ...	31	8	8	12	13	72
Shawyer, C. ...	do. ...	do. ...	27	9	8	12	14	70
Biglin, D. A. ...	do. ...	Gluyas Early	26	8	8	13	14	69
Turner, H. E. ...	N. Hyden ...	Glucub ...	26	9	8	12	14	69
Green & Atkinson	do. ...	Gluyas Early	25	9	8	12	14	68
Clayton, E. G. ...	do. ...	Merredin ...	21	9	7	13	14	64
Moulton, W. ...	Hyden ...	Glucub ...	23	8	8	12	13	64
McLennan, A. T. ...	do. ...	Waratah ...	23	8	7	12	13	63

Kukerin Agricultural Society.

The rainfalls as recorded at the respective centres are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Kukerin	147	30	97	34	271	300	125	189	141	248	1,274	10	12	1,604
Moulyinning	69	23	79	35	222	254	89	133	92	198	988	3	18	1,215

The awards made are as shown below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
English, J. C. ...	South Kukerin	Bencubbin ...	38	9	9	14	14	84
Bahr, E. G. ...	do.	Yandilla King	37	8	8	12	13	78
Pyke, G. ...	Kukerin ...	Free Gallipoli	33	8	9	13	13	76
Adams, T. ...	South Kukerin	Nabawa ...	31	9	8	12	13	73
Coates & Son ...	Moulyinning	Gluyas Early	28	9	9	13	14	73
Faulkner, W. J. ...	North Kukerin	Nabawa ...	31	8	9	12	13	73
Smith, A. H. ...	South Kukerin	Gluyas Early	31	7	9	12	14	73
Troup, A. ...	Kukerin ...	Free Gallipoli	28	9	8	14	13	72
Williams, T. C. ...	South Kukerin	Bencubbin ...	27	8	8	14	13	70
Ditchburn, R. & Son	North Kukerin	Free Gallipoli	24	8	8	13	13	66
Sugg Bros. ...	do.	Nizam ...	24	8	8	12	13	65
Daffor, J. ...	do.	Bencubbin ...	21	8	8	14	13	64

Kulin Agricultural Society.

The rainfalls as recorded at Kulin, Kulin Rock and Jilakin are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
Kulin	135	9	170	28	282	264	157	163	71	194	1,131	33	13	1,499
Kulin Rock	27	13	160	47	185	208	107	129	65	123	817	46	..	1,110
Jilakin	110	15	174	28	234	254	131	146	94	178	1,037	8	6	1,378

The awards made are tabulated hereunder:—

Competitor.	Address.	Variety.	Yield. 50 points	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Henderson, L. W. ...	Kulin ..	Glueclub ..	39	8	8	12	14	81
Trotter, A. W. ...	do. ...	do. ...	38	8	9	12	13	80
Freebairn, F. S. ...	Jilakin ...	do. ...	35	9	8	12	13	77
Russell & Bailey ...	Kulin Rock	Bencubbin ...	33	8	9	14	13	77
Nichols, R. ...	do. ...	do. ...	32	8	8	14	14	76
Scadding, N. A. ...	Jilakin ...	Glueclub ...	33	9	8	12	14	76
Melke, P. ...	Kulin Rock	Bencubbin ...	29	9	9	14	13	74
Bowey, P. J. ...	Kulin ...	Nabawa ...	28	9	8	13	13	71

ZONE 8.

Judge: N. Davenport, Agricultural Adviser.

Gnowangerup Society, 9 competitors; Wickepin Society, 4 competitors; Royal Agricultural Society, 3 competitors; Total, 16 competitors.

Gnowangerup Agricultural Society.

The rainfalls as recorded at Gnowangerup and Pallinup are as follow:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Gnowangerup ...	114	11	78	26	154	428	102	121	110	243	1,158	68	51	1,500
Pallinup ...	55	14	97	54	191	371	141	160	130	232	1,225	?	?	?

The awards made are shown below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Davis, D. ...	Kebaringup	Bencubbin ...	43	9	9	14	14	89
MacDonald, J. ...	Gnowangerup	do. ...	39	9	9	14	13	84
Cockram, C. ...	Pallinup ...	Yandilla King	39	9	9	14	12	83
Glengarie Estate ...	Gnowangerup	Bencubbin ...	38	9	9	14	12	82
Garnett, L. T. C. ...	Pallinup ...	Yandilla King	37	8	9	14	12	80
Griffiths, J. ...	Gnowangerup	Bencubbin ...	34	9	9	14	13	79
Taylor, C. ...	Pallinup ...	Yandilla King	36	8	8	13	13	78
Griffiths, H. ...	Gnowangerup	Bencubbin ...	32	8	8	14	12	76
House, W. L. C. ...	Kebaringup	Free Gallipoli	30	8	9	14	12	73

Wickepin Agricultural Society.

The rainfalls recorded are as follows:—

—	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
Wickepin ...	95	13	154	41	318	338	182	148	106	152	1,244	12	9	1,568
Toolibin (Colonic) ...	182	0	102	20	337	265	105	175	75	158	1,115	13	12	1,450

The awards made are shown below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
Hosken Bros. ...	Wickepin ...	Free Gallipoli	30	8	8	14	13	73
Clifford, T. ...	do. ...	Federation ...	26	9	8	13	12	68
Miller, S. H. ...	Toolibin ...	Free Gallipoli	21	8	8	14	12	63
Maxwell, F. C. ...	Wickepin ...	do.	20	9	8	13	11	61

Royal Agricultural Society.

The rainfalls as recorded at South Caroling and Quairading are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total.			
South Caroling (Woodstock)	115	2	145	40	196	181	134	110	56	161	838	6	3	1,149
Quairading ...	47	6	154	34	256	247	172	149	73	167	1,064	11	3	1,319

The awards made are as shown hereunder:—

Competitor.	Address.	Society.	Variety.	Yield. 50 points.	Free-dom from Weeds. 10 points	Free-dom from Disease. 10 points	Free-dom from Ad-mixture. 15 points	Even-ness of Growth. 15 points.	Total. 100 points.
Taylor & Sons	Quairading	Royal ...	Gluchub ...	30	9	9	14	14	76
Lohoar & Sons	do.	do. ...	do.	26	9	9	13	14	71
Richards, A.	South Caroling	do.	do.	27	8	8	14	13	70

ZONE 9.

Judge: J. Langfield, Manager, Merredin Experiment Farm.
Southern Mallee Society, 8 competitors.

Southern Mallee Agricultural Society.

The rainfalls as recorded at the various centres are as follow:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sep.	Oct.	Total			
Grass Patch (East)...	90	1	250	17	143	88	151	115	116	227	840	108	47	1,443
Kumarl ...	217	...	132	16	93	96	90	83	72	106	540	159	32	1,006
Sunrise Hill (The Grange)	84	...	80	11	97	117	89	103	69	98	573	178	14	940
Salmon Gums	201	...	222	12	126	138	139	88	70	126	687	184	26	1,332
Dowak (The Hermitage)	228	...	147	16	136	133	91	116	68	109	653	178	61	1 283

The awards made are as shown hereunder:--

Competitor.	Address.	Variety.	Yield. 50 points.	Free-dom from Weeds. 10 points	Free-dom from Disease. 10 points	Free-dom from Ad-mixture. 15 points	Even-ness of Growth. 15 points.	Total. 100 points.
Ritchie, D....	Grass Patch	Nabawa ...	25	8	8	14	13	68
Nulsen & Dunn ...	Kumarl ...	Gluyas Early	17	9	9	14	14	63
Salmon, W. ...	Sunrise Hill	do.	16	9	9	14	14	62
Johnston, J. F. ...	West Dowak	do.	13	8	9	14	12	56
Barry, T. ...	do.	do.	13	9	9	12	13	56
Morton, N. R. ...	Sunrise Hill	Nabawa ...	13	8	9	12	13	55
Thomas Bros. ...	Salmon Gums	do.	11	8	9	12	13	53
Chapman, F. ...	Dowak ...	Gluyas Early	8	7	8	13	12	48

ROYAL AGRICULTURAL SOCIETY—ZONE CHAMPIONSHIP AWARDS.

Representatives from District Agricultural Societies' Competitions and Entries received direct by the Royal Agricultural Society.

Competitor.	Address.	Society.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
ZONE 1.—Judge: G. L. Throssell, Agricultural Adviser.									
Bothe, B. D.	Coorow ...	Carnamah	Bencubbin	41	8	8	14	18	84
Carter, H. R.	Three Springs	Three Springs	Waratah	35	9	8	14	14	80
Lynch, P. J., Senator	do.	do.	Bencubbin	31	8	7	14	12	72
Forrester, J. K.	Carnamah	Carnamah	Bena ...	27	8	8	13	13	60
ZONE 2.—Judge: G. L. Throssell, Agricultural Adviser.									
Moore, Hon. T.	Indarra ...	Royal ...	Bencubbin	34	9	9	14	13	79
ZONE 3.—Judge: R. W. Prunster, Manager, Yilgarn Experiment Farm.									
Waterhouse, E. J.	Goomalling	Royal ...	Glucub ...	37	7	8	13	13	78
Bear, H. E.	Minnivale ...	Dowerin	Bencubbin	31	8	9	14	14	76
Hughes, J. R.	do.	do.	do.	35	8	9	10	18	75
Lane Bros. ...	Wongan Hills	Royal ...	Nabawa	28	9	9	14	14	74
Mt. Rupert Co.	do.	do.	Merredin	26	9	8	14	14	71
ZONE 4.—Judge: I. Thomas, Superintendent of Wheat Farms.									
Greagh Bros.	Kwelkan ...	Nungarin	Bencubbin	28	8	9	14	13	72
Perry Bros.	Bencubbin	Mt Marsh- all	Gluyas Early	29	8	7	13	14	71
Hopwood, B. W. G.	do.	do.	Bencubbin	26	9	8	14	13	70
Jolly, H. P.	Nungarin ...	Nungarin	Nabawa	24	9	8	14	14	69
Leyland, H.	Mukinbudin	Mukin- budin- Lake	Gluyas Early	25	9	8	13	14	69
Stevens, G. K.	S. Ghooli ...	Southern Cross	Bencubbin	25	8	9	14	14	68
Connor, T. ...	Mukinbudin	Mukin- budin- Lake	Gluyas Early	24	9	7	14	13	67
Davies, J. G. & F.	Southern Cross	Southern Cross	Noongaar	20	7	9	13	13	62
ZONE 5.—Judge: R. P. Roberts, Agricultural Adviser.									
Farrell, F. C. & Sons	Bruce Rock	Bruce Rock	Glucub	34	9	8	13	14	78
Teasdale Bros.	Belka ...	Bruce Rock	Bencubbin	34	8	8	13	14	77
Teasdale, F. O.	Korbel ...	Merredin	do.	31	8	8	14	14	75
Teasdale, H. W.	Ulva ...	do.	Totadgin	31	7	8	12	14	73
ZONE 7.—Judge: A. S. Wild, Agricultural Adviser.									
English, J. C.	S. Kukerin	Kukerin	Bencubbin	38	9	9	14	14	84
Henderson, L. W.	Kulin ...	Kulin ...	Glucub ...	39	8	8	12	14	81
Coad, J. ...	Lake Grace	Lake Grace	Bencubbin	35	9	9	14	13	80
Trotter, A. W.	Kulin ...	Kulin ...	Glucub ...	38	8	9	12	13	80
Bahr, E. O.	S. Kukerin	Kukerin	Yandilla King	37	8	8	12	13	78
Grant, L. J.	Karlgarin ...	Karlgarin	Bencubbin	32	9	8	14	14	77
McDonald, W. G.	Tinkurrin ...	Harris- mith	do.	32	8	9	14	13	76
Medcalf, C. W.	Karlgarin ...	Karlgarin	do.	32	8	9	14	13	76
Murray, A. ...	Tinkurrin ...	Harris- mith	do.	31	8	9	13	13	74
Harwood, W.	Lake Biddy	Lake Grace	Gluyas Early	22	9	8	13	13	65

ZONE CHAMPIONSHIP AWARDS—continued

Competitor.	Address.	Society.	Variety.	Yield. 50 points.	Free- dom from Weeds 10 points	Free- dom from Disease 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points.	Total. 100 points.
ZONE 8.—Judge: N. Davenport, Agricultural Adviser.									
Davis, D. ...	Kebarlingup	Gnow- angerup	Beneubbin	43	9	9	14	14	89
MacDonald, J.	Gnowangerup	do.	do.	39	9	9	14	13	84
Taylor & Sons	Qualradang	Royal	Glueclub ...	30	9	9	14	14	76
Hosken Bros.	Wickepin ...	Wickepin	Free Gal- lipoli	30	9	8	14	13	73
Lohoar & Sons	Qualradang	Royal	Glueclub ...	26	9	9	13	14	71
Richards, A.	S. Caroling	do.	do.	27	8	8	14	13	70
Clifford, T. ...	Wickepin ...	Wickepin	Federation	26	9	8	13	12	68
ZONE 9.—Judge: J. Langfield, Manager, Merredin Experiment Farm									
Ritchie, D. ...	Grass Patch	Southern Mallee	Nabawa	25	8	8	14	13	68
Nulsen & Dunn	Kumari ...	do	Gluyas Early	17	9	9	14	14	63

OBJECTS OF THE COMPETITION.

This competition was instituted with the object of improving the methods of general farming practised throughout the wheat belt. A spirit of healthy rivalry is engendered and competitors and others set themselves to follow those more successful than themselves. It is demonstrated that where recommended methods are employed, reasonable success follows.

THE SEASON.

The opening of the past season was an unfavourable one. Scattered rains occurred during March, but only in a few districts was it possible to commence active cultural operations in readiness for seeding.

No further rains of consequence fell until towards the end of May, with the result that seeding was generally much delayed.

Further copious falls until the end of June gave rise to excessive wet conditions which interfered with the destruction of weed growth and retarded seeding operations. Crops sown prior to the rain generally suffered much more from weed growth than those sown after it.

July rains were in most instances below the average, but the crops did not appear to be affected by lack of moisture. Rainfall registrations for the following month were above the average. The crops at this stage were backward, but with the advent of warmer weather and ample moisture at this period their growth increased considerably. Timely falls and suitable growing weather, except for a short period of hot weather and drying winds, occurred from then to maturity. The comparative late finishing of the season partly compensated for the late opening, but weed growth took its toll, from the earlier sown crops in particular.

Although frosts occurred in most districts, their intensity was not so marked as in previous years and comparatively little damage resulted.

ENTRIES.

Entries were received from 17 District Agricultural Societies and seven entries were received direct by the Royal Agricultural Society. In addition to these main

competitions, local competitions were held by the Kirwan and Wialki-Bonnie Rock Settlers' Associations and by the Bruce Rock and Phillips River Agricultural Societies. These local competitions included 28 competitors. Included in the competitions for Zone 4 were seven competitors who were eligible for the local but not for the main competition. In all, this was a total of 165 crops inspected, a decrease of 22 from last year.

The following table shows the progress of the competition since its inception in 1921:—

Year.	Number of District Agricultural Societies competing.	Number of Competitors.	Average Yield of Competitors.	Average Yield for State.
			bush.	bush.
1921 ... ..	...	15	25	10·4
1922 ... ..	...	32	24	8·9
1923	12	82	20	11·4
1924	15	70	31	12·8
1925	13	59	22·5	9·7
1926	11	99	24·5	12·0
1927	10	100	26·9	12·1
1928	13	114	22·5	10·1
1929	12	156	21·7	11·0
1930	15	165	27·4	13·3
1931	13	110	27·4	13·1
1932	17	168	29·3	12·3
1933	17	130	27·2	11·2*

* Estimate. District Agricultural Societies did not compete until 1923.

YIELDS.

To the competitor who obtains the highest calculated yield per acre from the competing area the Royal Agricultural Society has, since 1925, awarded a special prize of £5 5s.

The prize this year was won by Mr. D. Davis, of Gnowangerup, with a yield of 43 bushels per acre with the variety "Beneubbin."

The winners of the prize to date are:—

	Bus./Acre.
1925—Hebiton & Sons, Three Springs, "Nabawa" ..	34
1926—Cuming Bros., Carnamah, "Yandilla King" ..	38
1927—A. W. Parkinson, Gnowangerup, "Yandilla King"	40
1928—A. W. Parkinson, Gnowangerup, "Yandilla King"	40
1929—C. E. Cockram, Pallinup, "Yandilla King" ..	46
1930—C. Smith & Sons, Yarding, "Gluelub"	43
1931—H. O. Beeck, Gnowangerup, "Yandilla King" ..	42
1932—F. S. Freebairn, Jilakin, "Gluelub"	47
1933—D. Davis, Gnowangerup, "Beneubbin"	43

This year 87, or 67 per cent. of the crops were calculated to yield 25 bushels or over per acre, 47 or 36 per cent. to yield 30 bushels or over, and 16 or 12 per cent. to yield 35 bushels or over. The corresponding percentages last year were 80 per cent., 43 per cent., and 21 per cent. respectively.

These comparative percentage figures indicate the adverse effect of the season on higher yields as the methods employed by the competitors were quite up to the standard of last year.

Those competitors obtaining 35 bushels or over are as tabulated below:—

Zone.	Competitor.	District.	Society.	Variety.	Yield.
8	Davis, D. ...	Kebaringup ...	Gnowangerup ...	Bencubbin ...	bus. 43
1	Bothe, B. D. ...	Coorow ...	Carnamah ...	Bencubbin ...	41
8	Cockram, C. E. ...	Pallinup ...	Gnowangerup ...	Vandilla King ...	39
7	Henderson, L. W. ...	Kulin ...	Kulin ...	Ghulub ...	39
8	MacDonald, J. ...	Gnowangerup ...	Gnowangerup ...	Bencubbin ...	39
7	English, J. C. ...	South Kukerin ...	Kukerin ...	do. ...	38
8	Hengarie Estate ...	Gnowangerup ...	Gnowangerup ...	do. ...	38
7	Trotter, A. W. ...	Kulin ...	Kulin ...	Ghulub ...	38
7	Bahr, E. O. ...	South Kukerin ...	Kukerin ...	Vandilla King ...	37
8	Garnett, L. T. C. ...	Pallinup ...	Gnowangerup ...	do. ...	37
3	Waterhouse, L. J. ...	Goomalling ...	Royal ...	Ghulub ...	37
8	Taylor, C. ...	Pallinup ...	Gnowangerup ...	Vandilla King ...	36
1	Carter, H. R. ...	Three Springs ...	Three Springs ...	Waratah ...	35
7	Coat, J. ...	Lake Grace ...	Lake Grace ...	Bencubbin ...	35
7	Freemairn, F. S. ...	Jilakin ...	Kulin ...	Ghulub ...	35
3	Hughes, J. R. ...	Minivale ...	Dowerin ...	Bencubbin ...	35

The average calculated yield for all crops inspected was 27.2 bushels per acre.

The following table shows the comparison between the yield for the 1933 season and the previous five years:—

Zone.	Number of Competitors, 1933	Average Calculated Yield.					
		1933.	1932.	1931.	1930.	1929.	1928.
1	7	30.9	32.1	33.5	28.2	24.7	29.0
2	1	31.0	33.4	26.0	27.6	22.5	19.3
3	7	30.6	34.5	32.5	27.5	23.4	21.3
4	23	32.8	32.8	25.2	26.1	18.2	18.3
5	22	28.0	31.3	28.0	32.7	21.0	20.4
7	46	28.1	29.8	21.8	28.6	22.0	23.0
8	16	31.7	32.8	31.0	30.0	32.2	31.0
9	8	11.5	24.3	23.4	19.8	14.5	
Yearly figures ...	130	27.2	29.3	27.4	27.1	21.7	22.5

LOCAL CROP COMPETITIONS, 1933.

I. THOMAS, Superintendent of Wheat Farms.

For the past several years, in addition to the 50 acre crop competitions conducted by the Royal and District Agricultural Societies, other competitions were conducted by unaffiliated bodies or by agricultural societies who conducted competitions additional to those in connection with the parent body.

The District Agricultural Society of Bruce Rock conducted a 50 acre crop and fallow competition, and that of Phillips River a 50 acre crop competition.

The competition for the Bevan trophy was continued for another year by the Wialki-Bonnie Rock Settlers' Association, the condition being imposed for the first time that all competing crops should be grown on fallow.

The Kirwan Agricultural Bureau also conducted a 50 acre crop competition under the same conditions as govern the Royal Agricultural Society's competition although not affiliated with it.

The competitors for the above competitions totalled 32, and the average yield was 20.2 bushels per acre.

The following are the particulars of the respective competitions:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: R. P. Roberts, Agricultural Adviser.

The above society commenced a fallow and crop competition in 1932 for which there were five entries, the report on which appeared on page 234 of the June, 1933, issue of the *Agricultural Journal*.

In continuation of this competition crops were planted on the fallow so entered.

The combined awards made by the judge for both sections were as follow:—

Competitor.	Address.	Variety.	Yield. 50 points	Free- dom from Weeds, 10 points	Free- dom from Disease, 10 points	Free- dom from Ad- mixture, 15 points	Even- ness of Growth, 15 points	Total. 100 points	Fal- low. 100 points.	Total, Crop and Fal- low 200 points.
Farrall, F. C. & Sons	Yarding...	Glueclub ...	34	9	8	13	14	78	84	162
Pimlott, S. H.	Kwolyin	Sword ...	26	9	8	11	12	66	90	156
Brown, S. ...	Bruce Rock	Glueclub ...	27	8	7	13	14	60	85	154
Smith, C. & Sons	Yarding	do	31	6	7	13	13	70	82	152
Smith, C. & A. H.	Yalbarrin	do.	23	7	8	13	13	64	86	150

The rainfall as recorded at Bruce Rock was as follows:—

		Growing Period.											Nov.	Dec.	Total for year.
		Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Total.			
Bruce Rock	...	25	4	34	34	188	211	124	133	87	113	856	29	44	1,026

Phillips River Agricultural Society.

Judge: A. S. Wild, Agricultural Adviser.

The rainfall as recorded at Ravensthorpe was as follows:—

		Growing Period.													Total for year.
		Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	
Ravensthorpe	...	86	...	247	12	162	156	68	189	104	164	843	132	100	1,429

The awards made were as set out below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds, 10 points	Free- dom from Disease, 10 points	Free- dom from Ad- mixture, 15 points	Even- ness of Growth, 15 points.	Total. 100 points.
McCulloch, J. ...	Ravensthorpe	Gluyas Early	23	9	9	13	13	67
Campbell, J. ...	Mt. Short ...	do.	21	9	9	14	13	66
Bebbington Bros. ...	do. ...	do.	20	9	9	14	13	65
Chambers Bros. ...	Ravensthorpe	Merredin ...	22	9	8	13	13	65
Barrett Bros. ...	do..	Gluyas Early	19	9	9	14	13	64
Molr, M. ...	Kaybahup ...	Ford ...	21	9	8	12	14	64

Wialki-Bonnie Rock Settlers' Association.

Judge: N. Davenport, Agricultural Adviser.

The rainfalls as recorded at Wialki, Bonnie Rock, Karloning, and North Wialki are as follows:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Total.	Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sept	Oct.				
Wialki	12	79	114	20	208	359	186	223	50	64	1,040	?	?	?
Bonnie Rock	22	72	116	19	160	310	99	145	51	103	868	71	79	1,247
Karloning ... ..	...	88	81	16	144	287	90	169	48	90	828	81	?	?
North Wialki	18	133	80	12	248	382	134	178	59	105	1,106	2	126	1,477

The awards made are as shown below:—

Competitor.	Address.	Variety.	Yield. 50 points.	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth. 15 points	Total. 100 points.
Chamberlain & Pratt	North Wialki	Gluyas Early	23	9	9	14	14	69
Fuss, K.	Bonnie Rock	do.	22	9	9	14	14	68
Jackman, R. C. ...	do.	Bencubbin	22	9	9	14	13	67
Freedman, L. F. ...	do.	Gluyas Early	20	9	9	13	14	65
Hurt, W.	Wialki	Bencubbin	20	9	9	13	13	64
Richardson Bros. ...	Jouerdine	do.	19	8	9	13	13	62
Simpson, W. G. ...	N. Dalgouring	Gluyas Early	19	8	9	14	12	62
Dyer, F.	Wialki	Noongaar	16	9	9	13	13	60
O'Neill, J. H. ...	do.	Gluyas Early	17	8	8	14	13	60
Gale, S.	Bonnie Rock	do	16	8	9	14	12	59
Smith, E.	Wialki	do.	16	8	9	13	13	59
Borlase, J.	Karloning	do.	16	9	9	12	12	58
Irvine, L.	do.	Bencubbin	14	9	9	14	12	58
Gaffin, N. S. ...	Bonnie Rock	Gluyas Early	15	8	9	13	12	57

Kirwan Agricultural Bureau.

Judge: N. Davenport, Agricultural Adviser.

The rainfall as recorded at Kulja is as follows, those for Kokardine are not available:—

	Jan.	Feb.	Mar.	Apr.	Growing Period.						Total.	Nov.	Dec.	Total for year.
					May.	June	July.	Aug.	Sept.	Oct.				
Kulja	8	70	15	170	389	134	240	30	70	1,048	60	20	1,227

The following table shows the awards made:—

Competitor.	Address.	Variety.	Yield. 50 points	Free- dom from Weeds. 10 points	Free- dom from Disease. 10 points	Free- dom from Ad- mixture. 15 points	Even- ness of Growth 15 points	Total. 100 points.
Clover, H. G. ...	Kulja	Nabawa	20	9	9	14	13	65
Joynes, M. A. & G.	Kokardine	Merredin	20	7	9	13	13	62
Mitchell, J. A. & H. S.	Kirwan	Bencubbin	17	8	9	14	13	61
Montagu, J. S. ...	Koorda	Waratah	17	8	8	13	13	59
Strahan Bros. ...	Kulja	Gluyas Im- proved	20	7	7	13	12	59
Stanwix, E. S. ...	Kokardine	Gluyas Early	18	7	8	13	12	58
Leach, J. R. ...	Kulja	Merredin	13	6	9	13	10	51

DROOPING FLOWERED CLOVER SEED.

G. R. W. MEADLY, B.Sc., Botanical Branch.

Drooping Flowered Clover (*Trifolium cernuum*) is now one of the most useful annual clovers grown in Western Australia and consequently seed production, which commercially is only carried out locally, is of considerable importance.

Glancing through the average purity figures for a number of years it is quite evident that decided efforts are being made by producers to improve the quality of the seed. During the 1929/30 season the average purity was 69.2 per cent. This was followed in 1930/31 by 79.0 per cent.; 1931/32, 90.8 per cent.; and 1932/33, 92.7 per cent. Although the purity figure has increased annually there has been a corresponding, but in no way connected, decrease in germination. As far as our present knowledge holds this decline in germination cannot be countered during the growing stages, but fortunately the seed has definitely responded to treatment as shown by articles in issues of this "Journal." The treatment carried out with the Ames' hulling and scarifying machine has proved most successful, and farmers are definitely advised to purchase only scarified seed. The following table sets out clearly the position regarding Drooping Flowered Clover seed during the last few years.

Season.	Purity Average.	Germination.						Hard Seeds	
		Average.		Highest.		Lowest			
		Un- treated	Scarified.	Un- treated.	Scarified.	Un- treated.	Scarified.	Un- treated.	Scarified.
1929-30 ..	69.2	31	..	40	...	24	..	66	..
1930-31 ...	79.0	39	...	39	...	39	..	60	..
1931-32 .	90.8	6	40	15	47	0	31	94	59
1932-33 ...	92.7	5	51	15	63	1	35	93	47

In order to ascertain whether the germination figure for this season's seed was still low, a number of samples were secured from farmers and the results of tests tabulated as shown below:—

Sample.	Remarks.	Germination.	Hard Seed.
A	Hand cleaned	0	0
B	Machine dressed	3	96
C	Hand cleaned	16	83
D	Machine dressed	4	95
E	do.	4	95
F	do.	4	96
G	do.	2	97
G	Hand cleaned	1	98

Sample B was obtained from the same source as Sample A, and the results indicate that the machine used for cleaning had a mild scarifying effect on the seed, thus increasing the germination. Samples C, D and E were all obtained from another source, however, and show no difference between hand-cleaned and machine-dressed seed. One point is very evident from the above tests, viz., the germination of Drooping Flowered Clover seed is low again this season with a corresponding high "hard seed" content. The average germination of the seven samples is 5 per cent. with a "hard seed" content of 94 per cent.

The following table summarises the main results secured with the Ames hulling and scarifying machine during the past season (1932-33):—

Sample.	Weight.		Germination.		Hard Seeds.	
	Before Scarifying.	After Scarifying.	Before Scarifying.	After Scarifying.	Before Scarifying.	After Scarifying.
1	lbs. 2,084	lbs. 2,028	% 0	% 35	% 0	% 0
2	1,652	1,652	0	36	00	04
3	2,804	2,755	7	44	92	55
4	60	...	15	58	84	42
5	43	...	11	57	89	43

There was practically no loss of seed during the process as the machine is mounted on a concrete floor from which any spilt seed may be easily gathered. The loss in Sample 3 may be definitely attributed to dirty seed which it was found necessary to sieve before treating. This, together with the dust blown out during scarifying accounts for the comparatively large difference in weights.

With last season's averages of 5 per cent. and 51 per cent. for untreated and treated seed respectively, approximately 10 lbs. of untreated seed would be required to produce the immediate stand obtained from 1 lb. of scarified seed. Considering the price of Drooping Flowered Clover to be 2s. 6d. per lb., and taking into account the 3d. per lb. for scarifying, the respective costs for obtaining the same immediate stand would be 25s. and 2s. 9d.

Scarified Drooping Flowered Clover seed may be purchased from a number of local seed merchants, or the seed will be treated by the Department of Agriculture at a charge of 3d. per lb. Seed for treatment should be consigned to the Public Works Department, George Street, Perth, and notification forwarded to the Government Botanist, Department of Agriculture.

PRODUCTION OF "BANYULE SILVERMINE 55th" (25,473).

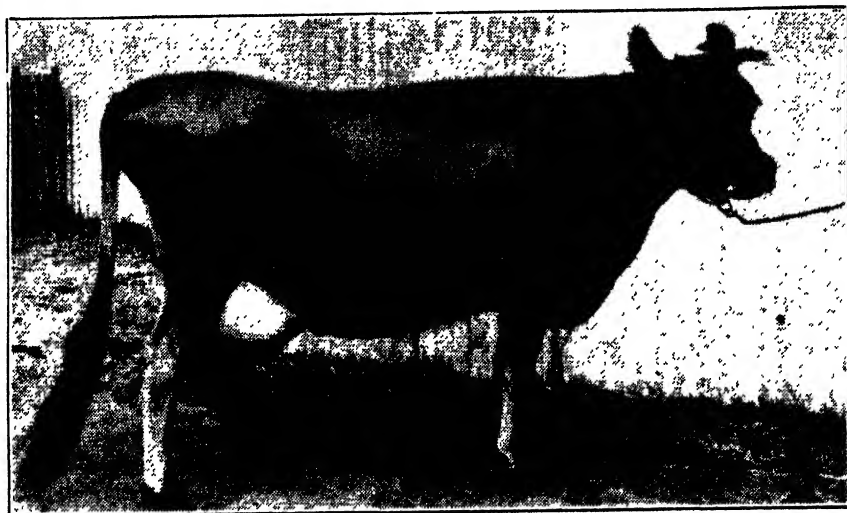
JERSEY RECORD FOR WESTERN AUSTRALIA.

G. K. BARON-HAY,
Superintendent of Dairying.

The Jersey cow "Banyule Silvermine 55th" (25,473), owned by the Sabina Vale Stud Farm, Wonnerup, by producing 10,887 lbs. milk and 660.55 lbs. butter fat in 273 days has created a new record for the Senior 4-year-old Class and for the Jersey breed in Western Australia.

Previous to this record, pride of place in this class for all breeds was held by the Australian Illawarra Shorthorn cow "Hope 3rd of the Hill" owned by Mr. W. G. Burges, "Tipperary," York, and which produced 13,423 lbs. milk and 606 lbs. butter fat in 273 days, the best Jersey yield in this class having been recorded by "Mokine Empire Lily 6th," owned by Mr. T. H. Wilding. "Mokine Empire Lily 6th," with a production of 9,652 lbs. milk and 591.49 lbs. butter fat as a Senior 4-year-old, still holds pride of place for cows bred in Western Australia.

In producing 660.55 lbs. butter fat in 273 days, "Banyule Silvermine 55th" also now holds the honour of being the highest producing Jersey cow in this State—a title held by the cow "Carnation of Dardanup" since 1923, then owned by Mr. R. H. Rose. "Carnation of Dardanup" produced 10,788 lbs. milk and 600.99 lbs. butter fat in 273 days.



Banyule Silvermine 55th.

The monthly yields of "Banyule Silvermine 55th" are shown hereunder:—

"BANYULE SILVERMINE 55TH" (25,473).

Date of Birth: 2nd August, 1928. Date of Calving: 25th May, 1933.

Standard: 330 lbs. Butter Fat in 273 days.

Monthly Production.

				Sub-Period	Milk.	Butter Fat	Herd Recorder
				lb.	lb.	lb.	
June ...	...	...	...	30 days	1,455	93.90	G. Ruthven
July ...	...	...	...	30 "	1,320	88.65	L. C. Snook
August ...	...	...	...	30 "	1,200	83.40	C. Gilles
September ...	...	...	...	30 "	1,125	59.28	L. C. Snook
October ...	...	...	...	30 "	1,170	62.55	C. Gilles
November ...	...	...	...	30 "	1,245	69.27	C. Gilles
December ...	...	...	...	30 "	1,170	67.08	C. Gilles
January ...	...	...	...	30 "	1,080	66.72	C. Gilles
February ...	...	...	...	33 "	1,122	68.80	L. C. Snook
Total	...	...	...	273 days	10,887	660.55	

Average Test 6.07 per cent.

For record purposes and the information of breeders, Table 1 sets out the highest producing cows in each class to February 28th, 1934, both for locally bred cows and including imported cows.

It will be noticed in Table 2 that the Jersey breed holds the highest records in all classes—except the Junior 2-year-old—for cows bred in Western Australia.

The monthly fodder consumed by "Banyule Silvermine 55th," together with the cost of feeding during the test period, is given in another article appearing in this issue of the "Journal," entitled "The Feeding of Concentrates to High Producing Cows under Test is Profitable."

TABLE 1.—BEST PRODUCING COWS IN EACH CLASS—PURE BRED HERD TESTING SCHEME TO 28TH FEBRUARY, 1934.

Class.	Name of Cow.	Breed.	Age.	Milk.	Average Test.	Butter Fat.	Owner.
273 DAY TEST.							
Mature ...	Picton's Trequean Flirt	Guernsey	6 1	13,452	5.18	697.98	A. W. Padbury
Senior 4 years	Banyule Silvermine 55th	Jersey ...	4 9	10,887	6.07	660.55	Sabina Vale Stud Farm
Junior 4 years	Lady Forbes Veeman	Friesian	4 5	16,533	3.17	524.88	A. L. B. Lefroy
Senior 3 years	Mokine Empire Lily 7th	Jersey ...	3 11	10,164	5.69	579.11	T. H. Wilding
Junior 3 years	Kitty 8th of Kurrawong	A.I.S. ...	3 4	9,814	4.82	473.26	W. G. Burges
Senior 2 years	Jean 2nd of Grass Vale	Jersey ...	2 9	8,701	5.84	508.93	R. H. Rose
Junior 2 years	Koojan Bo-Peep ...	Guernsey	2 1	6,750	5.77	390.15	A. W. Padbury
365 DAY TEST.							
Mature ...	Picton's Trequean Flirt	Guernsey	6 1	16,075	5.21	870.06	A. W. Padbury
Senior 4 years	Koojan Dulcie ...	Guernsey	4 10	12,782	5.79	740.81	A. W. Padbury
Junior 4 years	Lady Forbes Veeman	Friesian	4 5	20,130	3.28	660.24	A. L. B. Lefroy
Senior 3 years	Mokine Empire Lily 7th	Jersey ...	3 11	12,815	5.83	747.40	T. H. Wilding
Junior 3 years	Girle of Sarnia ...	Jersey	3 5	10,043	4.90	520.68	D. Malcolm
Senior 2 years	Jean 2nd of Grass Vale	Jersey ...	2 9	11,181	6.04	676.22	R. H. Rose
Junior 2 years	Lady Fowler 14th of Grass Vale	Jersey ...	1 11	9,365	5.57	521.86	R. H. Rose

TABLE 2.—HIGHEST RECORDS FOR COWS BRED IN WESTERN AUSTRALIA

273 DAY TEST.							
Class	Name of Cow.	Breed.	Milk.	Average Test.	Butter Fat	Owner at time of Test.	
Mature ...	Carnation of Dardanup ...	Jersey	lb.	9.	lb.		
Senior 4 years	Mokine Empire Lily 6th ...	Jersey ...	10,788	5.57	690.99	R. H. Rose	
Junior 4 years	Telvarup Duchess ...	A.I.S. ...	9,652	6.12	591.49	T. H. Wilding	
Senior 3 years	Mokine Empire Lily 7th...	Jersey ...	13,792	3.8	522.84	A. L. Grant	
Junior 3 years	Lily of Grass Vale ...	Jersey ...	10,164	5.69	579.11	T. H. Wilding	
Senior 2 years	Jean 2nd of Grass Vale ...	Jersey ...	8,772	5.03	442.87	R. H. Rose	
Junior 2 years	Koojan Bo-Peep ...	Guernsey	8,701	5.84	508.93	R. H. Rose	
			6,750	5.77	390.15	A. W. Padbury	

Tattoo No. 6881 Breed: Jersey Name: Banyule Silvermine 55th (25473) Owner's Name: West Australian Government Age: Born 2nd August, 1928 Bred by C. Gordon Lyon, Heidelberg Address: Victoria	Sire: Air Lord of Banyule (3337) Bred by C. G. Lyon, Victoria		G. Sire: Wotton Altman (Imp.) (2716) { { G.G. Sire: Red Cloud (11818), E.J.H.D. { G.G. Dam: Dairymaid, Vol. 29 { { Milk. lb. Av. Test. B. Fat. Days. { Average Produced 8,000 for 5 years.	
	G. Dam: Molly 6th of Banyule (7124) { { Milk. lb. Av. Test. B. Fat. Days. { Produced 12,497 4.9 61 487 ... { 5 years av. 10,416 ...		{ G.G. Sire: Audrey's Lord Twyllah (985) { G.G. Dam: Molly 4th of Banyule (4246) { { Milk. lb. Av. Test. B. Fat. Days. { Produced 9,966 5.0 505 ...	
	G. Sire: Lily 3rd's Prince of Fernree-V le (1940) { { G.G. Sire: Pearl's Prince of Holmwood (986) { G.G. Dam: Lily 3rd of Holmwood (5146) { { Milk. lb. Av. Test. B. Fat. Days. { Produced		{ G.G. Sire: Mabel's Chief (Imp.) (623). { G.G. Dam: Silvermine 3rd (715) { { Milk. lb. Av. Test. B. Fat. Days. { Produced 8,266 5.16 426	
	Dam: Silvermine 25th of Banyule (11602) Bred by C. G. Lyon, Victoria		G. Dam: Silvermine 20th of Banyule (7131) { { Milk. lb. Av. Test. B. Fat. Days. { Produced 6,374 5.81 370 380 Jnr. 2 yr. {	
	Dam: Silvermine 25th of Banyule (11602) Bred by C. G. Lyon, Victoria		G. Dam: Silvermine 20th of Banyule (7131) { { Milk. lb. Av. Test. B. Fat. Days. { Produced 6,374 5.81 370 380 Jnr. 2 yr. {	
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SPECIES TRIALS FOR NEW IRRIGATION AREAS.

T. C. DUNNE, H. K. GIBSON and G. GAUNTLETT.

The extension of irrigation in the South-West will, to some degree, bring under more intensive cultivation, areas of second class clay land which have previously neither received much cultivation nor have carried much pasture. Prior to the extension of drainage, these areas were waterlogged throughout the winter. The fertility of these soils is generally low.

During past years subterranean clover has improved the fertility of many originally similar areas in the South-West. However, in order to utilise the irrigation water provided, it is necessary to establish on unimproved land, pastures which are able to respond to application of water under these low fertility conditions and thereby make the use of water immediately profitable.

For this purpose a trial was conducted to determine species capable of giving satisfactory returns when established with a minimum of soil cultivation. The effects of a number of fertiliser mixtures was also investigated.

An area was selected at Wokalup for this trial. In its virgin state the land carried red gum, blue gum and blackboy and it was cut up by numerous crab holes and clay pans. The site for the trial had been cleared for some years previously. No sown pasture existed and the cover consisted mainly of sedges, silver grass and Guildford grass.

In preparation for the experiment the native growth was burned and a number of ant hills were broken down. Furrows were ploughed out for the purposes of irrigation and drainage. These led into a winter drain dug at one end of the plots. The area was cultivated twice each way with a spike harrow, but penetration was poor.

The area sown to each species was 15 links by 150 links. This was subdivided by the fertiliser treatments. The whole area of the trial covered just over half an acre. With the exception of *paspalum*, the seeds were sown on May 11, 1932, and the fertiliser applied at the same time. *Paspalum* was sown after watering in November, 1932. The fertiliser applications were subsequently repeated in the spring and autumn.

The species sown included the following, viz., strawberry clover, white clover, red clover, *Phalaris tuberosa*, perennial rye grass, Italian rye grass, tall fescue, meadow fescue, Kentucky blue grass, timothy, rocksfoot, meadow foxtail, and *paspalum*. In addition, the annual drooping-flowered clover was sown over the whole area.

The fertiliser treatments were: (a) Super, (b) Super, ammonia, (c) Super, ammonia, lime, (d) Super, ammonia, potash, (e) Super, potash.

With the exception of white and drooping-flowered clovers, the germination was poor, probably due to the fact that the soil had not been sufficiently disturbed for the covering of the seeds. The germination was best on the soil turned out of the irrigation furrows and where ant hills had been broken down. The month following sowing was very wet and cold. Growth generally was poor and, on the plots receiving ammonia, silver grass, which was considerably stimulated by the fertiliser had a very adverse competitive effect.

The first grazing was done in October 1932, and the next in February, 1933. Thereafter the stock (cows) were admitted more frequently and the plots were always heavily grazed with a view to cleaning up the natural species.

No attempt will be made to describe the response to the conditions of all the species. Attention will be given only to those plants which were most successful and which appear to be the most promising for similar areas.

New Zealand white clover was undoubtedly the most outstanding species sown. It responded particularly well to the first watering given in November, 1932, and thereafter spread rapidly. It was always the first species grazed by the stock and was usually eaten until only the runners remained. After grazing it made very rapid recovery and continued to spread until not only had it covered the area where sown but had, by means of runners, spread some distance into neighbouring plots. Not only did it provide feed during most of the year but the clover will undoubtedly cause a big improvement in the fertility and physical condition of the soil. The natural species (sedges, etc.) almost entirely disappeared on the white clover plots owing to the persistent grazing by the stock.

The annual drooping-flowered clover served its purpose of providing late winter and spring feed and thrived in the wet patches. This clover makes, of course, no summer growth.

Red clover did fairly well but, not being able to spread by means of runners like white clover, the poor germination prevented good yields.

Paspalum, though sown about six months later than the others, was easily the most successful of the grasses. It was evident that with sufficient summer moisture this species could make good growth even under conditions of low soil fertility. Much better growth could be expected if it were grown in association with white clover.

The other grasses were unsatisfactory and appeared to be unable to thrive under any of the fertiliser treatments. The best of a poor lot were tall fescue, Italian rye, cocksfoot and timothy. These species made best growth along the edges of the furrows and around the edges of the clay pans where some deposition of silt had occurred. These should be more satisfactory on the better soils of the irrigation areas.

There were no outstanding differences in the fertiliser treatments. Plots receiving ammonia were somewhat stimulated immediately after application but the duration of the effect was short. It was noticeable, however, that the stock had cleaned out the natural species more on the plots receiving ammonia than on adjacent plots where this fertiliser was not applied.

From the results of this trial, the conclusion arrived at is that, for those who are forced to establish pasture on the type of land under consideration, the best species would be New Zealand white clover and paspalum. White clover 2-4 lb. per acre and paspalum 8-12 lb. per acre should give a satisfactory mixture. White clover may be sown in the early winter or early spring but paspalum would be best sown at the time of the first irrigation.

As a method of establishment the procedure adopted in this trial is not to be recommended. Where undisturbed, there is a hard surface layer on the soil and the germination of seeds is poor. The uneven nature of the surface causes waterlogged patches during the winter and in the summer makes irrigation very difficult and wasteful of water. Good cultivation, on the other hand, would cause better germination and would have some effect in evening the surface.

From data obtained the following scheme suggests itself as worthy of trial on unimproved areas. To loosen the soil and to help even the surface, the land could be ploughed in autumn and a winter-crop of oats sown. Following this a

further ploughing would still further even the land and would prepare for the sowing of Sudan grass and paspalum according to the method described by Gibsone and Gauntlett in a previous issue of this Journal (June, 1933). In order to secure good germination and growth of paspalum the seeding of Sudan grass should not be too heavy. After the removal of the Sudan grass, a light harrowing would sufficiently loosen the surface soil for the introduction in the autumn of white clover (2-4 lb. per acre) among the existing paspalum plants. A few pounds of Italian rye grass with the white clover would provide early winter feed but if this were added it would be necessary to completely cover the seed. A good stand of white clover and paspalum should be obtained the following summer.

MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied the following information regarding Produce available for auction in the Perth Railway Yards, for the period December to February inclusive:—

December.—The supplies of Wheaten Chaff during this month were slightly over the demand, and f.a.q. to prime was selling at from £3 17s. 6d. to £4 per ton, but towards the end of the month supplies weakened, and the market firmed to £4 5s. 0d. F.a.q. was then making £3 17s. 6d. to £4.

Oaten Chaff.—Prime quality was changing hands at £3 17s. 6d. to £4 2s. 6d., and f.a.q. at £3 15s. 0d. per ton.

Oats.—Heavy supplies were arriving, and good heavy feeds were making from 1s. 8d. to 1s. 9d. per bushel; good feeds 1s. 6d. to 1s. 7d.

Wheat.—In the early part of the month under review the market was firm. F.a.q. wheat was selling at 2s. 9½d. to 2s. 10d., but towards the end of the month the market eased to from 2s. 7d. to 2s. 7½d. per bushel, and second grade was making from 2s. 3½d. to 2s. 4½d.

January.—The supplies of Chaff arriving were sufficient to meet the demand, and f.a.q. to prime Wheaten Chaff was realising £4 5s. 0d. per ton; f.a.q. £3 17s. 6d. to £4; prime Oaten Chaff £4 5s. 0d., and f.a.q. £3 17s. 6d. to £4.

Oats.—Good heavy feeds were making from 1s. 10d. to 2s. per bushel, and good feeds 1s. 8d. to 1s. 9½d.

Wheat.—F.a.q. was selling at from 2s. 6d. to 2s. 7d., and there were several consignments of premium wheat sold at 2s. 10½d. to 3s. per bushel. Second-grade made 2s. 3d. to 2s. 4d., and smutty and inferior from 2s. to 2s. 2d.

Barley.—There were fair supplies of good feed Cape and Chevalier Barley finding their way to auction, and same were selling freely at from 1s. 10d. to 2s. 1d. per bushel.

February.—F.a.q. to prime Wheaten Chaff was making £4 7s. 6d. to £4 12s. 6d. per ton, and f.a.q. £4 2s. 6d. to £4 5s. 0d. Prime Oaten Chaff sold at £4 to £4 2s. 6d., and f.a.q. £3 15s. 0d. to £3 17s. 6d.

Oats.—Supplies of Oats were short, and the market firm. Good heavy feeds were making from 2s. 3d. to 2s. 4d. per bushel, and good feeds 2s.

Wheat.—F.a.q. was selling at from 2s. 5d. to 2s. 6d. per bushel, second-grade 2s. 2d. to 2s. 3d., and smutty and inferior at from 1s. 10d. to 2s. per bushel.

Barley.—This was finding buyers at from 1s. 9d. to 2s. per bushel.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Co., Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS FOR MONTHS OF DECEMBER, 1933, JANUARY AND FEBRUARY, 1934

	December.			January.					February.			
	6th.	13th.	20th.	3rd.	10th.	17th.	24th.	31st.	7th.	14th.	21st.	28th.
Sheep ...	10,649	12,869	13,302	11,704	11,544	13,458	11,319	8,331	9,717	10,650	10,834	11,328
Cattle ...	233	602	783	604	702	765	686	650	649	571	615	582
Pigs ...	1,465	1,578	2,266	961	1,230	1,743	1,574	1,236	1,724	1,349	1,232	1,297

COMPARATIVE VALUES PER POUND.

Mutton ...	3½d.	3½d.	4d.	4½d.	4½d.	4½d.	4½d.	4½d.	4½d.	4½d.	4½d.	4½d.
Beef ...	4d.	4d.	4½d.	4½d.	4½d.	4½d.	4½d.	4½d.	4d.	4½d.	4d.	4½d.
Pork ...	6½d.	6½d.	6½d.	6½d.	7d.	6½d.	6½d.	7d.	7d.	7d.	7½d.	7½d.
Bacon ...	5½d.	5½d.	5d.	5½d.	5½d.	5d.	5½d.	5½d.	6d.	5½d.	6d.	6d.

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.			
	Maximum.		Minimum.		For Month.	Aver. age.		
	Mean.		Highest.					
	Mean.	Highest.	Mean.	Lowest.				
DECEMBER, 1933								
Chapman State Farm	92.6	107.8	62.8	54.0	1.02	24		
Geraldton	84.7	105.0	61.7	47.2	1.13	13		
Woolbing	91.2	108.4	61.0	48.1	1.16	47		
Perth	83.0	102.8	62.9	52.2	1.04	76		
Kalamunda	80.3	102.8	59.8	48.2	1.00	78		
Bunbury	79.9	92.6	57.7	46.7	1.14	57		
Bridgetown	84.5	97.0	53.0	48.0	1.32	32		
Albany	73.0	94.0	57.3	49.0	1.82	87		
Merredin State Farm	90.2	107.2	61.3	51.3	1.32	35		
York	91.2	107.2	61.3	51.0	N/H	N/H		
Narrogin State Farm	90.0	106.5	59.5	49.0	N/H	N/H		
Katanning	88.8	102.0	54.1	42.5	1.18	34		
Cape Leeuwin	72.3	89.6	50.6	44.7	1.28	63		
				56.0	2.25	83		
JANUARY, 1934								
Chapman State Farm	95.0	112.1	68.3	57.8	1.42	29		
Geraldton	86.4	103.0	68.3	50.9	1.46	22		
Woolbing	96.0	114.0	65.1	50.0	1.17	33		
Perth	87.8	110.2	66.3	58.6	1.27	34		
Kalamunda	91.6	108.3	64.0	53.7	1.12	52		
Bunbury	83.4	93.1	61.5	54.0	1.24	43		
Bridgetown	80.3	108.0	56.6	42.2	1.40	56		
Albany	75.8	88.3	60.9	50.3	1.43	85		
Merredin State Farm	96.6	110.3	66.0	53.8	1.33	48		
York	95.9	112.3	65.3	54.4	2.12	27		
Narrogin State Farm	94.8	112.0	63.5	53.0	1.35	30		
Katanning	91.7	107.7	58.9	48.0	1.62	36		
Cape Leeuwin	89.2	106.6	58.8	48.7	1.40	38		
	74.1	79.0	63.8	58.0	1.42	63		
FEBRUARY, 1934.								
Chapman State Farm	97.8	109.0	69.0	56.0	1.01	42		
Geraldton	87.7	102.5	70.9	62.0	N/H	28		
Woolbing	93.4	113.0	65.7	52.0	1.23	40		
Perth	88.5	108.8	67.4	53.8	1.16	41		
Kalamunda	89.9	104.3	63.0	51.7	1.32	59		
Bunbury	84.4	108.0	63.4	45.0	1.33	52		
Bridgetown	80.7	102.0	55.5	37.2	1.20	75		
Albany	78.0	101.8	60.9	49.8	1.76	91		
Merredin State Farm	96.0	108.6	63.4	49.2	1.13	52		
York	95.8	112.0	63.7	54.0	1.34	38		
Narrogin State Farm	94.2	108.5	63.7	51.0	1.18	43		
Katanning	91.2	103.3	59.2	43.4	1.09	52		
Cape Leeuwin	89.3	102.6	59.1	44.0	1.25	54		
	76.1	84.4	65.3	58.0	1.27	82		

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THE NITROGEN SUPPLY OF AN APPLE ORCHARD.

A Review of the question and description of an experiment conducted in the
apple orchard of Mr. J. Cross at Argyle, Western Australia.

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INTRODUCTORY.

The problems of orchard management, particularly those relating to manurial treatments and cultural methods, have received several decades of intensive investigation. Until 1920, the work was carried out principally in the Agricultural Experiment Stations of the United States of America, and consisted generally of long time field experiments in which various manurial treatments and cultural methods were compared. After 30 years of experimenting along these lines it became apparent to investigators that the field experiments did not contribute greatly to the knowledge of the nutrition of fruit trees and that this method of attack would have to be supplemented by careful parallel chemical and physiological studies. The paper by Alderman (1919), summarising the American work by 28 different experiment stations and stressing the inadequacy of the field experiment method, has been referred to in this Journal by the Director of Agriculture, Sutton (1931). The situation regarding the problems of fruit tree nutrition is reviewed by Wallace (1933). It seems that this field work, while yielding little of fundamental significance to the understanding of the fruit tree, has been of importance to the fruit industry in showing the uncertainty of positive results from fertiliser applications over a wide range of soil and climatic conditions; in showing

the importance of proper cultural methods; and in laying the foundations for the newer methods of research in fruit growing. To quote Wallace (1933):—

"It will be apparent . . . that specific recipes for the manuring of fruit can have little practical value. The only sound basis for the intelligent use of manures on fruit trees is a detailed knowledge of the factors concerned in any particular instance.

"Thus he (the farmer) must acquaint himself with the peculiarities as regards nutrition of his various plants, with the effects of special local conditions of climate and soil, and with the reaction of his trees, at various stages, to details of management."

Of the fertilisers, nitrogen has most consistently given positive results in America, and in England, potassium. Mineral fertilisers in general have proved at least equal to organic manures.

The new method of attack involves research into the various phases of fruit tree nutrition.

1. The effect of deficiency of various elements such as nitrogen, potash, magnesium, phosphate, etc., when trees are grown under laboratory and field conditions. The behaviour of the trees under laboratory conditions has been used for the diagnosis of nutritional disorders and deficiencies in the field with an encouraging degree of success.

2. A study of the stock and scion relationships. This has resulted already in the orchardist being able to secure carefully standardised trees and bushes of various types of fruit, thus simplifying many problems in management.

3. The control of quality. Management and manuring practice affect the quality of the fruit. Thus good cider apples are associated with low nitrogen supply and the best vintage fruit is obtained from old trees under grass orchard conditions. Similarly, low cultivation, combined with careful nitrogen fertilisation, is practised to yield best quality dessert apples.

4. The inter-relations of the various essential elements affect the response to fertilisation. It is observed that nitrogen accentuates potassium deficiency and excess nitrogen may lead to the symptoms of potassium starvation in orchards otherwise adequately supplied. Lime may induce chlorosis and, in addition, may lower potassium availability.

It is in the light of this latest information, and using the new methods of horticultural research, that the problems of the fruit growers in this State must be attacked, and the experiment described was arranged to afford data concerning the behaviour of two orchard soils prior to arranging field experiments which must be supplemented by chemical and physiological data. It is confidently expected that co-operation between the growers and the investigators in horticulture will yield information which will assist each individual orchardist to understand more fully his trees and his soils and will lead to improved management and economy in fertilisation.

Fertiliser requirements of the apple tree with particular reference to nitrogen:—

It is apparent that it is exceedingly difficult to determine the fertiliser requirements of the apple tree, and impossible to lay down precise recipes for general use. Individual cases must be treated individually; in fact, in many instances the tree must be regarded as the unit and treatment varied accordingly for best results.

While manurial experiments, particularly in the case of young orchards, have generally given results lacking in uniformity, it is a fact that there is a continual drain on the soil by the growing trees, and care must be taken to maintain and even improve the orchard soils by management and fertiliser practice. Trees may

be slow in showing symptoms of starvation, but they are also slow in recovery; the problem must be anticipated to avoid a lengthy and unprofitable period of recovery.

Gourley (1914, 1919) reported in Gardner, Bradford and Hooker (1922), p. 206, states that his experimental plots in New Hampshire gave no response in yield to fertilisers after five years; and again after 10 years no response in yield was observable but "the orchard is developing in that direction." It seems that, sooner or later, depending on the conditions, fertilisation will be needed in a bearing orchard and the rational management programme involves the use of sufficient fertiliser, economically to maintain the orchard and to avoid otherwise inevitable depletion.

To discuss only the nitrogen requirements, Gardner, Bradford and Hooker (1922), p. 138, state that the nitrogen content of parts of a 30-year old apple tree were as given in Table 1.

TABLE 1.
Nitrogen content of fractions of a 30-year old apple tree.

Fraction.	Total Nitrogen in the Fraction.
	lbs.
Fruit	0.57
Leaves	0.87
New growth	0.03

Another investigator (*ibid.*) found that 1,000 lbs. of fresh apples (fruit) contained 1.05 lbs. of nitrogen.

As the fruit is the only portion removed it is seen that a crop yielding 250 cases (10,000 lbs.) per acre would remove 10.5 lbs. of nitrogen per acre from the orchard. This loss is made good by the use of fertilisers and by the micro-biological and other processes in the soil. Where nitrogenous fertilisers give no response in yield or growth it is evident that the natural soil processes and the reserves are adequate, at least for immediate purposes—nitrogen is not the limiting factor.

In America, nitrogen fertilisation has given most consistent increases in returns on older trees, on trees in a weakened conditions, and on orchards under grass or sod. Gardner, Bradford and Hooker (1922) give interesting data in Table 68, p. 206, from which the information in Table 2 is taken.

TABLE 2.
Yield of fruit and leaf weight in an apple orchard under different systems of management and the relation to the nitrates in the soil.

Treatment.	Nitrates p.p.m. Dry Soil.	Yield of Fruit per cent.	Fresh Leaf Weight per cent.
Sod	3.18	100	100
Cultivation odd years ... ..	...	132	111
Clean culture	17.40	213	123
Cultivation and cover crop	33.91	216	123
Cultivation, cover crops and complete fertilisation ... ..	...	191	135

Where cultivation enabled the soil to yield plant food as shown by the increase of nitrates in the soil, complete fertilisation in addition to cultivation effected no benefit—except in vegetative growth. Excessive increase in vegetative growth may be detrimental to the yield of fruit, particularly in dry seasons.

There are many cases recorded, principally of weak trees, in which nitrogenous fertilisers (sodium nitrate) applied in the spring have greatly increased the setting of the fruit and the yield, and have greatly increased the size of the fruit. (Information from Gardner, Bradford and Hooker (1922), p. 208, Table 69, p. 209, Table 70, p. 210.)

TABLE 3.
Effect of nitrogenous fertilisers on apple trees in weak condition.

Treatment.	Reference.	No. of Blossoming Spurs.	Percentage of Fruit Set, Sept. 30th.	Yield per Tree. (bushels.)
Check	Gardner, Bradford and Hooker	483	16.4	3.75
Sodium nitrate	Table 69, page 209	542	30.7	21.50
Per cent. Grading.				
		175 to 150 per bushel.	138 to 112 per bushel.	100 and larger per bushel.
Check	Table 70, page 210	22.09	39.76	38.15
Sodium nitrate	... ..	2.28	26.91	70.76

Nitrogen deficiency in apples may be gauged from the symptoms given by Wallace (1933) pp. 6 and 7—

*“Nitrogen deficiency—*In pot experiments the omission of nitrogen from nutrient solutions produces deleterious effects more quickly than the omission of any other of the major essential elements, and with young trees under this treatment the growth made during the first season is frequently similar to others receiving a complete starvation diet of ‘water only.’ The times of opening of blossom and leaf buds are delayed, blossom formation is drastically reduced owing to the death of lateral buds, and the flowers are very weak. Foliage is relatively scanty, and after a season or two of the treatment the trees usually only carry foliage at the tips of the shoots, thus presenting a characteristic ‘bare-wood’ appearance. The leaves are relatively small and yellowish green in colour and often develop orange or reddish tints towards the end of the season. Small reddish brown spots may appear on the leaves. Shoot growth is drastically reduced, and after a short period of treatment the trees fail to make appreciable shoot growth. Defoliation is premature and the tints at defoliation time are reddish yellow. The barks become pale brown in colour. Fruiting is quickly reduced to a negligible amount owing to the non-development of lateral buds. Fruits are small, often highly coloured or of chlorotic appearance, relatively hard in texture, and with high sugar : nitrogen ratio. They possess excellent storage qualities both in ordinary and low temperature stores. The root systems are small in proportion to the amount of shoot growth made, and are composed mainly of fine fibrous rootlets. Nitrogen starvation is of frequent occurrence under grass systems of cultivation and is easily remedied in such cases by cultivation. Trees in low nitrogen conditions react readily to applications of nitrogenous fertilisers.”

THE SUPPLY OF NITROGEN TO THE ORCHARD.

Nitrogen is supplied to the crop by means of fertilisers and by means of soil management—cover crops, legumes, etc. It seems that each orchardist must determine for himself, with the aid of expert advice coupled with field observation and experiment, the most economic and satisfactory treatments for his orchard.

(a) *By means of fertilisers.*

Nitrogenous fertilisers may be used profitably in many instances. Knowlton and Hoffman (1932) advise that early spring application, about two weeks prior to flowering, is found to be the most satisfactory time generally for readily available nitrogen. It was found that nitrate of soda equalled ammonium sulphate as a source of readily available nitrogen, but the ammonium fertilisers require the maintenance of the lime status of the soil. Nicholson and Pantin (1929) found a loss of over 50 per cent. of the nitrogen applied as ammonium sulphate, calcium cyanamide and rape dust, by drainage during the winter months, November to April.

Nitrogen, moreover, is a costly fertiliser. The cheapest form at the present time is ammonium sulphate which is quoted at £12 10s. per ton, in Perth. This is equivalent to 6½d. per lb. of nitrogen. A dressing of 3 cwts. per acre costs £1 17s. 6d., plus freight and handling expenses.

It is felt that nitrogenous fertilisers, which have to be purchased, should be used as supplements—to correct any seasonal deficiency of nitrogen not made good by the soil processes under proper management. It seems certain that, on the more fertile soils at least, the need for nitrogen can largely be met by that produced in the soil. Nitrogenous fertiliser can be used when environmental conditions are unfavourable for the natural processes to produce the quantities required by the trees. Experience shows that the most economical returns from outlay are obtained if the application of nitrogenous fertiliser is made just prior to flowering, before the soil agencies have accelerated, following the winter lag.

(b) *By means of natural soil processes.*

In the soil, processes occur whereby nitrogen gas of the air is converted into nitrogenous compounds which are useful for the growth of plants. *First*, nitrogen gas is utilised by certain soil micro-organisms in building up nitrogenous compounds in their bodies. Principal among these are the free living organisms, *Azotobacter* spp., *Clostridium Pasteurianum*, etc., which live on plant and animal residues, and the *Rhizobium* spp. living in the nodules on the roots of leguminous plants—peas, beans, clovers, etc. The total nitrogen content of the soil is increased by these agencies. *Second*, these organisms die and their bodies decompose, liberating ammonium compounds. *Third*, the ammonium compounds are changed to nitrates by the nitrifying organisms and in this condition are most readily available for the growth of the crop.

Depletion also occurs and nitrogenous compounds of the soil are lost by drainage, by absorption and removal in crops and by conversion into nitrogen gas. It is found that the nitrogen content of the soil is rather closely related to the amount of organic matter present, the ratio of carbon to nitrogen being approximately 10 to 1 under European and American conditions.

It is necessary, therefore, to adopt a soil management programme which will favour the maintenance of, or even increase, the content of organic matter, and hence nitrogen, and to adopt methods which will render the nitrogen available to the plant at the proper times and limit the need for the use of costly amendments.

THE SUPPLY OF ORGANIC MATTER AND NITROGEN IN THE SOIL.

In all soils there occurs a certain amount of organic matter which is the residue of the bodies of plants and animals in various states of decomposition. It is often referred to as "humus" and contains the bulk of the soil nitrogen. The ratio of

organic matter, expressed as organic carbon, to total nitrogen is relatively constant and, as mentioned above, averages about 10 parts of carbon to 1 of nitrogen. The organic fraction is of utmost importance in the soil and its quantity, similarly with nitrogen, is governed by an interaction of factors—climate, soil properties, soil management, etc. Organic matter and nitrogen are normally lower in soils under higher temperature conditions and are lower in sandy soils than in the heavier textured soils. Russell (1932) p. 364 suggests the following limits of nitrogen in English soils, under humid conditions, in relation to texture. Between these limits the values may be maintained by management—high values being obtained under grass and leguminous crops and low values when the ground is continually cultivated.

Nitrogen—Percentage in dry soil.

Limits.	Black Organic Soils—over 10 % Organic Matter (% N.).	Chalk Soils (% N.).	Clays (% N.).	Loams (% N.).	Sands (% N.).
Upper	3.0	0.42	0.35	0.25	0.20
Low	0.25	0.13	0.09	0.09	0.03

Continual cultivation tends to lower the organic matter and nitrogen content of the soil and it is found that this loss cannot be replenished by the use of artificial nitrogenous fertilisers. Accumulation and replenishment take place under sod or pasture and depleted soils are renovated by putting under permanent pasture for a period.

As the soil organic matter is the food of many of the soil micro-organisms, which are responsible for the production of much of the available plant food in the soil, and also affects materially the soil structure, moisture relations and other properties important in plant growth, it is of utmost importance to maintain it at an adequate level. The effects of cultivation in hastening depletion must be counteracted. Of course, one of the objects of cultivation is the acceleration of the release of plant food for the benefit of the crop, and the effects of this acceleration must be met by a management programme calculated to balance the increased loss and maintain the soil organic matter at a satisfactory level.

This is accomplished—

- (a) By the use of organic manures, stable manure, etc.
- (b) By reversion to sod, or grazing conditions at suitable intervals.
- (c) By the systematic use of green manures.

It is considered that the third method, the use of green manures, is most satisfactory for orchard practice in this State. Anthony (1925) shows that this method, particularly if legumes are used, will maintain the soil organic matter, while continuous cultivation without a cover crop leads to stunted trees.

Lipman *et al* (1928) have shown that a legume in the cover crop is necessary to maintain the level of the soil nitrogen. Other investigators support this finding. By this means the legume bacteria, *Rhizobium* spp., supplement the activities of the free living nitrogen fixers in the soil (*Azotobacter* spp., etc.) in the maintenance of the nitrogen (and organic matter) content of the soil.

Thus cover crops, including a suitable legume, are adequate to maintain the organic and nitrogen reserves of a soil under orchard conditions.

THE SUPPLY OF SOIL NITRATES.

The soil organic matter decomposes in the soil and a portion of the nitrogen is converted into the form of ammonia and nitrate, leading to a general enrichment of the soil solution and an enhanced supply of other plant requirements. Russell (1932) p. 236 summarises the situation with reference to the soil content of nitrate nitrogen as follows:—

“Rich garden soil may contain 60 or more parts per million, arable soils 2 to 20 p.p.m., pasture soils rather less and woodland soils still less.”

The fluctuations are enormous and depend on the soil, the season, the meteorological conditions and the plant cover on the soil.

In a very general way the nitrate nitrogen cycle of a soil is an index of the potential soil fertility. The accumulation of nitrate indicates that the soil is in a suitable condition for the activities leading to the formation of nitrate and in many instances these conditions are also favourable for the growth of crop plants.

Seasonal fluctuations in nitrate nitrogen content are enormous and in many instances recorded (Russell (1932) pp. 435, 436) follow the season activity of micro-organisms, being more plentiful in spring and autumn and at a minimum in winter and sometimes in summer. There is much evidence which suggests that there is generally one maximum and one minimum during the year, the maximum corresponding with spring and summer months and the minimum with the winter months. The curve reported by Russell (1932) p. 237 Fig. 29, showing seasonal variations at Rothamsted in 1915, supports these observations. The normal variability of figures for the soil content of nitrate nitrogen discussed by Prescott and Piper (1930) and observed by all workers in this field renders the observed minor maxima and minima of rather doubtful significance.

Regarding these fluctuations:—

(1) The losses of nitrate nitrogen from the soils are frequently very difficult to explain, particularly under very dry conditions such as prevail during the Australian summer. Russell (1932) p. 366, cites the experience of F. J. Martin and R. E. Massey at the Wellcome Research Laboratory, Khartoum, 1923, where first foot figures varied from 8 p.p.m. nitrate nitrogen to nil under rainless conditions and without irrigation, during the months September to March inclusive.

	Sept	Oct.	Nov	Dec	Jan	Feb	Mar
Nitrate Nitrogen p.p.m	8	2	2	1	2	Trace	Nil

Russell does not give the moisture contents of the soil at the various samplings, or the relation of carbon and nitrogen in the soils.

This and similar observations have not yet been explained. It is known, however, that nitrate nitrogen is lost by leaching during wet periods, by absorption by micro-organisms, by reduction to gaseous nitrogen in denitrification and by absorption by the growing crop. The effect of the growing crop (barley) on the nitrate nitrogen in soils is shown very clearly by the soil solution studies in the University of California by Stewart (1918) and by Burd and Martin (1924). In these tank experiments the nitrate nitrogen dropped from a concentration of from 50 to 150 p.p.m. of the dry soil at planting to nil or but a few p.p.m. during the period of most active growth: between 8 weeks and 16 weeks after planting. After about 16 weeks from planting the concentration of nitrate nitrogen again showed an increase, the production exceeding the utilisation. This represents the general experience reported in the literature for annual crops.

In connection with studies on an orchard soil at Davis, California, carrying peaches and pears, Proebsting (1929) found that the production of nitrate exceeded utilisation throughout the summer months, which is the period of active growth of the trees, showing that data from experiments with cereals cannot be applied to orchard conditions. The minimum nitrate nitrogen figures were obtained in April (early spring) in the check rows (winter cover crop and clean summer cultivation), the fall to the minimum and the following rise being rapid in each case.

(2) The increases in concentration of soil nitrate are also rather difficult to explain in some cases. Warm, moist conditions, where there is a favourable source of nitrogen supply in the soil, are conducive to nitrate formation and cultivation causes acceleration. The greatest accumulation normally occurs in the surface layers or in the mulch. It is suggested that the subsoil is fed with nitrates leached from the surface (Beaumont and Crooks (1933)).

The principal agencies in these fluctuations—production and consumption of nitrates—are, most probably, biological, including crop plants, bacteria, fungi, algae, etc. Recent investigations in India by Rao and Dhar (1931) and Dhar *et al* (1933) indicate the possibility of a photochemical action in the surface of the soil causing the oxidation of ammonia to nitrate; that is the action of the sunlight on the soil induces nitrate formation without the intervention of bacteria, and is an additional factor to be considered.

The losses and gains in nitrate nitrogen in the soils of the orchard described below have been brought about by the interaction of some or all of the factors mentioned. The problem is exceedingly complex, and the figures obtained for nitrate nitrogen in the soil, determined by the Devarda method, represent the amount left over after the producing factors have acted and the consuming factors—the crop, drainage, soil organisms, etc.—have taken their toll.

In cropped soils, when this figure is high and is maintained, it indicates that the soil is rich and is probably in good condition for the growth of the crop; and furthermore, production approximates utilisation. A falling figure for nitrate nitrogen indicates that the various factors causing depletion are more active than those leading to nitrate formation; when the nitrate nitrogen figure is low and remains low, it is probable that the soil is of low inherent fertility and it is possible that nitrate production is a limiting factor.

EXPERIMENTAL.

It is desirable that advisory work should be based as far as possible on local data. Where local data do not exist the experience of other places has to be used as a guide. Orchard fertilisation is but imperfectly understood, even in countries where most work has been done, and in our discussions with the Director of Agriculture on this matter, it was apparent that a programme of soil investigation would be of great value to horticultural advisers and to growers in this State. Knowledge of the nitrogen cycle in the soils of a representative apple orchard would provide the basis for a scientific programme of fertilisation and the reduction of wastage. The keen interest taken by the orchardists generally greatly facilitated and encouraged the initiation of the work, and Mr. J. Cross, of Argyle, very kindly made his orchard available for the study.

The location of the Experiment.

Argyle is an apple-growing centre in the valley of the Preston River, situated some four miles west of the town of Donnybrook and about 21 miles south-east of

the port of Bunbury. The rainfall is generous, but the bulk falls within the winter and early spring periods. The rainfall recorded at Donnybrook in points is as follows (100 points equal one inch):—

Year.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1933	38	37	72	126	387	1,209	805	469	435	583	33	32	4,226
Average 33 years	44	65	108	175	570	783	780	601	480	305	114	66	4,093

On the average, 572 points, or 14.0 per cent., are recorded during the six months November to April inclusive, and 3,519 points, or 86.0 per cent., fall during the remaining six months of winter and early spring. The soils will be subjected to quite severe leaching during the winter months, and management must be devised to reduce the effect on the soil to a minimum.

History and Development of the Orchard and the Orchard Management.

(By G.W.W.)

Although Argyle, as stated above, is mainly an apple growing centre (that fruit comprising the major portion of the quantity produced) the district is situated in one of those favoured spots where climatic and soil conditions enable apples, pears, stone and citrus fruits to be grown successfully.

In this connection it is interesting to note the work done by the early pioneers of the industry, who, without any precedent to guide them, took up the task of finding out by actual trial what kinds of fruits would prove most profitable to grow. One of these, Mr. Stanley Parke, who came to Western Australia from Victoria in 1899 and took up land near Donnybrook for the purpose of fruit-growing, planted out a number of different kinds including red and white currants, English gooseberries, English plums, apples, pears, cherries, oranges, etc., and not only were all those fruits represented, but there were many varieties, particularly of apples. Stanley Parke did his work well, and passed on, and the area under orchard on the property has since been greatly increased by his sons, but it is significant of the knowledge gained that the old portion that once was a trial ground for so many kinds and varieties of fruits, now contains only commercial varieties of apples and pears.

Mr. Cross' orchard is situated near the above-mentioned place, and some of the first trees planted in 1906 by Mr. Abe Hurst (the former owner) were obtained from the late Mr. Parke. The old orchard from where the soils for testing were taken is comprised of "Dunns" apple trees (figure 7), 22 years of age, in very healthy condition, the annual terminal growth averaging from 1ft. to 1ft. 6ins. in length, and there is no question that their sustained vigour is due in large measure to the thorough husbandry practised by Mr. Cross ever since he became the proprietor of the property. He has the good fortune to possess one essential, and one valuable aid to success as an orchardist. The first is a temperament which combines energy and optimism, and the second, a helpful and cheerful wife and family.

The trees in the younger portion (figure 8) of the orchard where soil samples were taken were planted by Mr. Cross, and are now 8 years old. They comprise apples—"Dunns," "Granny Smith," "Delicious" and "Doherty"; peaches—"Madame Sturtridge"; and English plums—"President" and "Grand Duke." This year the

terminal growths on the apple trees ranged from 2ft. 6ins. to 4ft. in length, and that on stone fruit trees from 2ft. 6ins. to 6ft.

Mr. Cross has been, and is, a stronger believer in fertilising the soil. He has varied the quantities and kinds but the yearly application is never missed. The old orchard in some seasons has been fertilised at the rate of 8 cwt. of potato manure, and the young orchard at 4 cwt. per acre, with an additional 2 cwt. of sulphate of ammonia per acre amongst heavy cropping trees, and 1 cwt. sulphate ammonia amongst the balance.

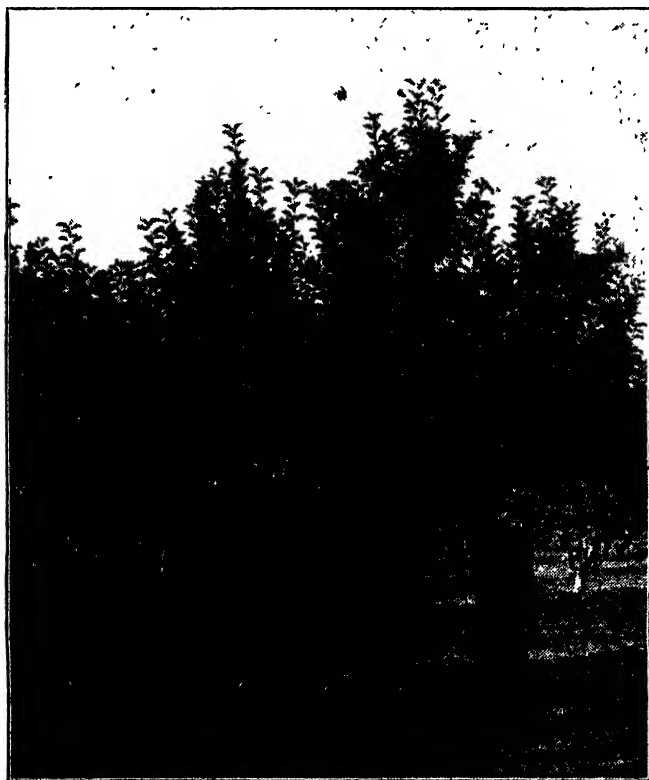


Figure 7. "Dunns."

In recent years he has applied 2 cwt. sulphate of ammonia and 2 cwt. superphosphate per acre per annum in April, and another 3 cwt. sulphate of ammonia per acre with the spring ploughing at the end of August, and it was the doubt expressed by officers of the department as to the wisdom of applying a nitrogenous fertiliser for deciduous trees in autumn that led up to the present tests.

For the first five years after planting, the weed growth in the orchard consisted mainly of clovers, but after that period clovers gave place to Cape-weed and wild geranium.

Cultivation commences by ploughing, about the end of August, as soon as the ground is in a fit condition after the winter rains; cross ploughing is done as soon as the weeds are sufficiently rotted, and then the land is kept in good tilth with spring-tooth cultivators and harrows until the end of December.

The soils of the orchard.

The principal rocks of the area are of the granite type intersected by basic dykes. On higher levels, the rocks are overlaid by a duricrust formation of lateritic material, probably representing a fossil soil horizon, Prescott (1931, p. 71. During the course of erosion, valleys have been cut through the duricrust formation exposing the country rock. The agricultural activities are confined almost entirely to these valleys where the richer soils occur associated with the weathering of the granites, etc., and showing only some admixture of lateritic material.

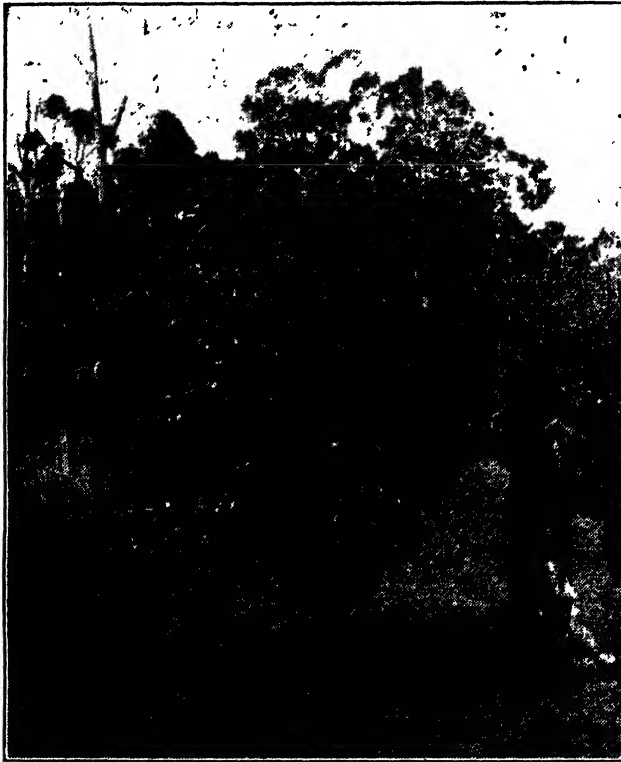


Figure 8. "Granny Smith."

The soils of the orchard under investigation at Argyle are principally alluvial, and occur on a terrace 20 to 25 feet above the river level. A small area of river flat, some three or four feet above river level and subject to periodic flooding, is also being developed. Sampling was confined to two soil types on the upper terrace.

Type A is a reddish-brown very sandy loam associated with the Preston River. From the river banks and observations in a drain 12-15 feet deep, it seems that this soil is many feet deep (12 or more). The profile in the drain exhibited no marked genetic changes to the full depth but washes of rounded, waterworn pebbles in the form of pockets, were observed at various levels. The principal timbers in the virgin state were red gum (*Eucalyptus calophylla*) and jarrah (*E. marginata*).

Type B is a brown sandy loam on a yellowish sandy clay loam at a depth of about 17 inches. This soil is much shallower, granite grit and granite being en-

countered up to six feet deep in the sites investigated. Granite outcrops occasionally occur. Type B appears to be associated with two small creeks, tributaries of the Preston River, and its occurrence suggests that it is formed on an alluvial fan. One site sampled to 6½ feet deep showed brown sandy loam to 17 inches on a yellow sandy clay loam. At four feet, with the appearance of the C horizon, the texture changed to a clayey, sandy grit showing mica, quartz sand and some rounded pebbles, suggestive of water action. The vegetation on this soil type resembled that on the first.

Both soils are regarded as eminently suitable for apple production, and the returns under proper management have been satisfactory.

Chemical Properties and Mechanical Analysis.

(Examinations made in the Government Chemical Laboratory).—

(a) Content of organic carbon and total nitrogen.

Samples were examined from type A in the apple orchard and from type B in the apple orchard, in pasture and in the virgin bush adjacent. The data are expressed in Table 4.

TABLE 4.

Organic carbon and total nitrogen content of soils of the orchard. Sampled 24th January, 1933.

Type.	Depth.	Condition.	Organic Carbon.	Total Nitrogen.	C : N Ratio.	Organic Matter. ($\times 1.724$).
A	Inches.	} Apple orchard cultivated ... }	%	%		
	0-6		1.92	.084	20.4	3.37
	6-12		.84	.045	18.6	1.45
	12-24		.36	.028	12.9	.62
B	0-5	} Virgin bush ... }	2.45	.102	24.0	4.23
	5-17		.73	.041	17.8	1.26
	17-30		.36	.029	12.4	.62
B	0-5	} Apple orchard cultivated ... }	1.61	.077	20.9	2.78
	5-16		.73	.039	18.7	1.26
	16-30		.18	.028	6.4	.62
B	0-3	} Pasture ... }	1.97	.113	17.4	3.40
	3-17		.82	.030	22.8	1.41
	17-30		.50	.029	19.3	.96

The soils of this orchard are on the low side for total nitrogen and organic matter when compared with the standards suggested by Russell (1932) and with the soils of King Island (off the coast of Tasmania) studied by Stephens and Hosking (1932), where the rainfall is similar but less concentrated in the winter months. The ratio of organic carbon to nitrogen is definitely high compared with Old World standards, but approximates the ratio found at King Island. In that investigation, of 62 soils examined, 18 soils showed ratios of from 10 to 15, 19 soils showed ratios of from 15 to 20, and 10 ratios of from 20 to 25. For mallee soils in South Australia, Prescott and Piper (1932) found a mean ratio of about 15; likewise definitely high as compared with data from the Northern Hemisphere.

This means some excess of organic carbon in relation to nitrogen which would tend to depress nitrate formation, but would favour the fixation of nitrogen from the air and the enrichment of the soil with respect to total nitrogen. None of the soils can be described as good with respect to organic matter, and the orchard soil (Type B) sample analysed is definitely lower than that from the pasture or virgin country, suggesting the depletion of the soil organic matter by cultivation.

(b) *Content of phosphoric oxide (P_2O_5), potash (K_2O), and lime (CaO):—*

TABLE 5.

Content of P_2O_5 , K_2O , and CaO in soil types "A" and "B" at Argyle. Soluble in conc. hydrochloric acid, expressed as per cent. dry soil. Sampled 9th January, 1934.

Site No.	Soil Type.	Treatment.	Constituents.	Analysis.					
1	A	Apple orchard 22 years old	...	Sample ...	...	1	2	3	
			P_2O_5	Depth (ins.)	...	0.6	6-12	12-30	
			K_2O	Percentage	...	101	027	033	
			CaO	do.	...	075	065	074	
				do.	...	338	281	216	
3	A	do. do	...	Sample ...	...	7	8	9	
			P_2O_5	Depth (ins.)	...	0.6	6-12	12-30	
			K_2O	Percentage	...	115	038	041	
			CaO	do.	...	077	057	114	
				do.	...	340	267	222	
6	B	Virgin forest	...	Sample ...	...	16	17	18	
			P_2O_5	Depth (ins.)	...	0.5	5-17	17-30	
			K_2O	Percentage	...	052	054	061	
			CaO	do.	...	071	095	096	
				do.	...	218	139	146	
9	B	Apple orchard 8 years old	...	Sample ...	...	25	26	27	
			P_2O_5	Depth (ins.)	...	0.5	5-16	16-30	
			K_2O	Percentage	...	068	082	052	
			CaO	do.	...	092	055	093	
				do.	...	252	097	091	

The two soil types are quite distinct chemically, with respect to phosphoric oxide (P_2O_5) and lime (CaO). Type A appears lower in phosphoric oxide and richer in lime. The figures for potash are comparable in both types and are definitely on the low side, particularly where clay accumulation is observed in Type B.

An interesting observation is the high figure for phosphoric oxide (P_2O_5) in the surface soil of Type A in the old orchard. This undoubtedly reflects the effect of many years of liberal treatment with superphosphate and shows that the phosphate is not removed by leaching but remains in the surface layers where it was applied.

(c) *Mechanical analysis:—*

TABLE 6.

Mechanical analysis and reaction of soils from the orchard at Argyle. Sampled 9th January, 1934.

Soil Type	A.			A.			B.			B.		
Treatment	Apple orchard, 22 years.			Apple orchard, 22 years.			Virgin forest.			Apple orchard, 8 years.		
Soil No.	1	2	3	7	8	9	16	17	18	25	26	27
Depth (ins.)	0-6	6-12	12-30	0-6	6-12	12-30	0-5	5-17	17-30	0-5	5-16	16-30
Fraction—												
Stones and roots	...	...	...	...	...	...	...	...	...	...	...	...
Coarse sand	14.0	13.2	12.2	14.9	13.4	10.5	20.4	18.9	12.2	30.8	25.1	19.2
Fine sand	64.4	65.5	66.5	64.9	68.1	65.3	45.4	46.4	44.5	41.1	42.6	38.1
Silt	7.2	7.2	8.4	7.8	6.9	9.3	12.0	13.1	14.5	9.9	1.9	9.6
Clay	10.5	12.6	12.6	8.8	10.0	15.4	13.2	20.1	29.7	13.0	28.0	31.1
Loss on acid treatment	1.2	.6	.5	1.2	.5	.6	1.0	.5	.9	1.5	.8	.8
Moisture	...	...	...	...	...	...	...	...	...	...	...	...
Loss on ignition	1.4	1.2	2.0	1.3	.9	1.1	1.8	1.9	2.3	1.6	1.3	2.0
Reaction*, pH	4.2	2.6	1.8	4.3	2.4	2.8	4.6	4.1	4.4	5.9	3.7	5.0
	5.23	5.06	5.76	5.04	5.80	6.03	6.30	6.30	6.05	5.34	5.34	5.56

* By quinhydrone method using 1 part of air dry soil to 2.5 parts of distilled water.

Of particular interest is the predominance of the fine sand fraction in both soil types. The ratio of fine sand to coarse sand in type A is 5.05 to 1 and in type B is 2.1 to 1. Generally in Western Australia, the coarse sand fraction seems to predominate (Simpson and Teakle (1934)).

The soil reactions are normal for a humid climate. The figures suggest that the use of sulphate of ammonia has lowered the pH value, *i.e.*, has made the soil slightly more acid, in the orchard soils. As yet the lime status seems satisfactory, but depletion by the continued use of acid forming fertilisers such as sulphate of ammonia must be watched very carefully.

Determination of the fluctuations of nitrate nitrogen in the soils.

As described above, the orchard consists of two portions—the old section on soil type A and the new section on soil type B. The trees in the old section are 22 years old and those in the new, 8 years old.

Sampling was arranged to afford data concerning the fluctuations of nitrate nitrogen in the soil—

- (a) of the two sections of the apple orchard;
- (b) of virgin timber land of type B adjacent to the orchard;
- (c) of pasture land of type B adjacent to the orchard, under the system of farm management adopted by Mr. Cross.

Later, a small plot was dug and maintained free of weeds to obtain figures for the course of nitrate formation under fallow conditions.

Sampling was done by means of an auger using a 4-inch "Iwan" post-hole digger. Three samples representing the surface, subsurface and subsoil layers were taken from each site; four sites were examined in each section of the apple orchard and in the pasture, and three sites were sampled to represent each of the other conditions, virgin, and fallow.

The surface layer varied from 3 inches to 6 inches deep and was sampled according to the profile or layers in the soil; the subsurface layer was sampled to a depth of 12 to 17 inches according to the profile, and the subsoil was taken to a depth of 30 inches below the surface.

After thorough mixing, a portion of the sample obtained by means of the auger was taken in a mason jar containing pieces of cotton wool soaked with toluene to depress bacterial activity during transit to Perth. The use of toluene is generally recommended for the preservation of soil samples in the study of nitrate fluctuations, Whiting and Schoonover (1920) p. 49. The lids were screwed on tightly to prevent loss of moisture and toluene vapour. Each sample was treated separately.

On arrival at the laboratory, generally after a period of about 24 hours, the samples were placed in a refrigerator running between 35deg. and 40deg. F. and kept in cold storage until required for analysis. Extraction of nitrates was made with utmost expedition, using two parts of distilled water to one of soil and the amount was determined by the Devarda reduction method. It is realised that the figure obtained will include any water soluble ammonia extracted with the nitrates, but the fraction is described as *nitrate nitrogen* for the sake of simplicity. This is claimed to be physiologically as valuable as nitrate and, therefore, of equal importance in this investigation. Water soluble ammonia was estimated on certain of the samples and was found to be very small—almost within the limits of error. The figures obtained ranged from nil to about 1 p.p.m. ammonia nitrogen in the dry soil. Ammonia will be important only in the soils depleted of nitrate.

Total ammonia was estimated by the Waite Method, Prescott and Piper (1928), on certain of the samples taken on April 4, 1933, with the results given in Table 7.

TABLE 7.

Total ammonia nitrogen in soils sampled April 4, 1933, at Argyle (p.p.m. on dry soil basis)

Type.	Site.	Depth.	Condition.	Ammonia nitrogen p.p.m.
A	1	ins.	} Apple Orchard cultivated }	5.0
		0-6		6
B	5	12-24	} Virgin Forest }	5.4
		0-5		1.0
B	8	17-30	} Apple Orchard Cultivated }	4.0
		0-5		1.0
B	12	16-30	} Pasture }	0.1
		0-3		1.6
		17-30		

The total ammonia nitrogen may constitute an important portion of the mineral nitrogen in the soil and in some instances where the nitrate nitrogen, determined by the Devarda method, was low, even exceeded this fraction in amount. As the bulk of the ammonia nitrogen will be held in the colloidal material of the soil—the clay and organic matter—it is not released by simple water extraction, and only a small portion, from a trace to about 1 p.p.m. of the dry soil, is represented in the nitrate nitrogen fraction. Furthermore, unlike the nitrate nitrogen fraction, it is not lost readily by the leaching action of heavy rains. It is, however, available for nitrification—the production of nitrate—and is a very valuable fraction, physiologically, in the soil.

The relation between total ammonia nitrogen and nitrate nitrogen is illustrated in Table 8.

TABLE 8

Relation of total ammonia nitrogen determined by the Waite method, Prescott & Piper (1928) to nitrate nitrogen determined by the Devarda method in soils sampled April 4, 1933.—(figures on dry soil basis).

Soil	Site	Depth	Condition.	Total* ammonia nitrogen p.p.m.	Nitrate nitrogen p.p.m.	Ratio—nitrate to total ammonia nitrogen
A	1	(ins.)	} Apple Orchard }	5.0	37.8	7.6 : 1
		0-6		6	7	1.2 : 1
B	5	12-24	} Virgin Forest }	5.4	4.5	0.8 : 1
		0-5		1.0	.6	0.6 : 1
B	8	17-30	} Apple Orchard }	4.0	15.9	4.0 : 1
		0-5		1.0	1.0	1.0 : 1
B	12	16-30	} Pasture }	9.1	4.6	0.5 : 1
		0-3		1.6	3.1	1.9 : 1
		17-30				

* Water soluble ammonia nitrogen will be considerably less than these figures—generally less than 1 p.p.m.

The results of the investigation into the fluctuations of the nitrate nitrogen, together with soil moisture and rainfall data, are given in Tables 9, 10, and 11 and represented graphically in figs. 1-6.

TABLE 9.
Showing average concentration of nitrate nitrogen in surface, subsurface, and subsoil layers of the orchard at Avrigle—expressed as p.p.m. N in dry soil.

Sampling Date.	Rainfall for Period.	Surface (0-3ins. to 0-6ins. deep).					Subsurface (to 12-17ins. deep).					Subsoil (to 30ins. deep).				
		AA ppm.	BA ppm.	BP ppm.	BF ppm.	BV ppm.	AA ppm.	BA ppm.	BP ppm.	BF ppm.	BV ppm.	AA ppm.	BA ppm.	BP ppm.	BF ppm.	BV ppm.
1933—																
January 24th ...	Ins. (from January 1st)	79.1	19.2	23.7	...	7.0	3.2	1.6	3.2	...	1.1	1.1	0.7	2.0	...	0.2
March 4th ...	0.38	24.3	11.1	13.7	...	3.2	2.4	2.1	2.3	...	1.7	1.3	1.3	2.2	...	0.8
April 4th ...	0.72	27.8	11.7	9.2	...	3.1	3.7	2.8	4.3	...	1.2	2.4	1.1	2.4	...	0.7
May 9th ...	0.37	37.3	7.0	13.0	...	3.0	2.7	1.0	2.8	...	1.5	1.2	0.8	1.7	...	1.0
June 9th ...	1.36	2.8	1.8	5.0	...	3.6	1.7	1.3	3.8	...	1.3	14.6	3.4	6.8	...	1.0
July 11th ...	12.00	4.4	2.5	3.6	...	2.6	1.4	2.0	2.4	...	1.5	0.9	0.9	2.4	...	1.3
August 9th ...	8.81	2.0	2.2	2.6	...	5.7	2.2	1.7	5.3	...	3.7	0.9	1.2	3.9	...	2.3
September 12th ...	3.71	2.4	1.9	2.0	20.9	2.2	2.6	1.7	2.3	9.0	2.3	0.7	0.4	1.1	0.9	1.4
October 9th ...	6.62	2.4	4.8	4.4	22.8	3.4	3.6	3.3	3.1	19.2	1.7	3.0	1.8	5.3	17.2	1.0
November 8th ...	4.59	7.5	7.1	12.7	55.0	3.2	7.0	2.5	10.0	20.0	2.0	3.4	2.6	7.7	13.7	1.1
December 12th ...	3.10	51.5	6.4	11.0	33.3	2.3	4.0	2.3	3.8	11.3	7.3	3.1	2.6	2.1	5.9	2.4
1934—																
January 9th ...	0.55	42.2	16.4	24.0	27.5	3.4	6.0	2.3	2.9	10.1	2.0	1.8	1.0	1.5	5.2	1.1
January 9th ...	0.50	61.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...
AA—Soil type A, old apple orchard, 22 years old. Average of four samples.																
B, pasture. Average of four samples.																
BA—Soil type B, young apple orchard 8 years old. Average of four samples.																
BP—Soil type B, fallow. Average of three samples.																
BF—Soil type B, virgin forest. Average of three samples.																

TABLE 10.
Amounts of nitrate nitrogen in the soil to a depth of 30 inches in relation to season, rainfall, and fertilizer applications.
(Figures express pounds of nitrogen per acre.)

Date of Sampling.	Rainfall for period.	Nitrogen applied as fertilizer prior to sampling.					Amounts of nitrate nitrogen (lbs. per acre).							
		inches.	lbs. per acre.	...	...	...	Soil type A, old apple orchard.	Soil type B, young apple orchard.	Soil type B, pasture.	Soil type B, virgin forest.	...	...	...	...
1933—							lbs. per acre.	lbs. per acre.	lbs. per acre.	lbs. per acre.	...	...	...	...
January 24th ...	0.38 (from Jan. 1)	...	...	...	...	...	160.3	38.4	50.6	...	...	14.1	...	...
March 14th ...	0.72	...	...	...	...	...	57.2	30.0	34.7	...	...	14.1	...	...
April 4th ...	0.37	...	...	...	...	...	73.1	32.8	38.4	...	...	12.2	...	...
May 9th ...	1.36	...	...	...	...	...	83.4	16.2	33.8	...	...	14.1	...	...
June 14th ...	12.00	...	...	...	...	...	90.9	22.5	48.8	...	...	15.0	...	...
July 11th ...	8.81	...	...	...	...	...	11.9	15.0	24.4	...	...	15.0	...	...
August 9th ...	3.71	...	...	...	...	...	18.8	41.2	41.2	...	...	31.9	...	...
September 12th ...	6.62	...	...	...	...	...	13.1	11.3	16.9	94.7	...	17.8	...	...
October 9th ...	4.59	...	...	...	...	...	...	...	...	...	...	...	...	...
November 8th ...	3.10	...	...	...	...	...	31.9	27.2	30.9	176.2	...	13.0	...	...
December 12th ...	0.55	...	...	...	...	...	123.8	27.2	90.9	167.8	...	10.9	...	...
January 9th ...	0.50	...	...	...	...	...	104.1	29.1	38.4	117.2	...	40.3	...	...
...	...	...	...	...	...	...	127.5	38.4	46.9	90.4	...	16.9	...	...

TABLE 11.
Showing average moisture content of surface, sub-surface and sub-soil layers of soil of the orchard at Arripk—expressed as per cent. of the dry soil.

Sampling Date.	Rainfall for period. (inches.) (from Jan. 1.)	Surface (0-3ins. to 0-6ins. deep)					Sub-surface (to 12ins.-17ins. deep)					Sub-soil (to 30ins. deep)				
		AA	BA	BP	BF	BV	AA	BA	BP	BF	BV	AA	BA	BP	BF	BV
1933—																
January 24th	0.38	% 2.7	% 5.2	% 1.6	% ...	% 3.6	% 3.0	% 9.1	% 5.8	% ...	% 4.0	% 4.7	% 12.5	% 10.0	% ...	% 6.4
March 14th	0.72	4.4	6.9	3.4	...	4.4	4.5	10.9	9.4	...	5.4	5.1	12.6	11.4	...	5.7
April 4th	0.37	3.4	6.0	3.5	...	6.0	5.1	9.9	7.8	...	6.8	5.7	11.1	8.9	...	8.1
May 9th	1.36	5.3	7.6	4.3	...	7.3	5.3	11.4	9.5	...	7.1	6.2	12.6	11.9	...	8.1
June 14th	12.00	18.0	19.8	18.0	...	26.5	17.8	22.0	19.5	...	18.7	18.5	22.5	20.1	...	19.8
July 11th	8.81	18.2	21.8	19.0	...	23.0	18.0	21.9	18.2	...	20.6	20.1	22.1	19.5	...	21.7
August 9th	3.71	16.6	19.7	16.2	...	19.4	16.0	19.5	16.2	...	18.4	19.3	21.4	18.9	...	23.6
September 12th	6.62	16.8	19.3	18.5	17.7	21.4	17.2	19.6	17.4	17.4	20.0	20.1	22.3	19.1	18.3	20.8
October 9th	4.59	16.6	19.2	18.5	18.1	22.3	16.4	19.6	16.4	13.7	19.1	17.9	21.5	19.2	16.6	18.9
November 8th	3.10	13.5	16.5	8.1	8.5	12.5	14.4	17.8	12.4	13.0	16.5	14.6	20.1	16.3	15.6	15.4
December 12th	0.55	9.2	13.6	3.4	6.0	5.9	8.1	16.3	8.9	12.9	10.4	11.2	18.4	12.3	10.8	8.8
January 9th	0.50	4.7	8.0	3.4	5.2	5.2	4.4	11.9	9.4	12.2	5.1	7.3	13.8	12.6	13.3	8.8

AA—Soil type A, old apple orchard—22 years old. Average of four samples.

BA—Soil type B, young apple orchard—8 years old. Average of four samples.

BP—Soil type B, pasture. Average of four samples.

BF—Soil type B, fallow. Average of three samples.

BV—Soil type B, virgin forest. Average of three samples.

DISCUSSION.

The nitrate nitrogen constitutes but a small fraction of the total nitrogen in the soil. In this investigation the nitrate nitrogen ranged from 0.9 p.p.m. to 90 p.p.m., i.e., from .00009 per cent. to .009 per cent. in the surface soils. The total nitrogen content of the surface soils ranged from .077 per cent. to .113 per cent., so that this water soluble portion ranged from one-tenth to one-thousandth of the total nitrogen. The total nitrogen represents the reserve from which the available and water soluble fraction is formed—and every care must be taken to maintain and protect this reserve.

This investigation proves that the orchard soils studies at Argyle, although on the low side for *total* nitrogen or reserve nitrogen, have a very considerable capacity for the production of nitrate nitrogen during the spring and summer months which is the period of active growth by the fruit trees. Furthermore, that the soils are reduced to almost complete depletion with respect to nitrate during the cold, wet winter months. This is in keeping with the results obtained elsewhere and shows that we can benefit from experience in orchard management in other parts of the world, particularly in America. The minor fluctuations in the graphs are regarded as being of little importance on account of the factor of soil variability which is particularly prominent in the nitrate fraction. Prescott and Piper (1930) have given some evidence in this connection. Evidence obtained in this investigation is no less striking as seen in Table 12.

TABLE 12.
Variations of nitrate nitrogen content of samples from surface soils—Argyle.

Month	Site	Old apple orchard, type A—0-6ins. p.p.m. N.	Pasture, type B Surface soil p.p.m. N.
January	1	85	13.6
	2	71	13.1
	3	95	55
	4	65	13.1
April	1	38	4.5
	2	28	12.9
	3	16	13.1
	4	30	6.1
June	1	1.8	2.7
	2	1.7	12.9
	3	1.5	2.0
	4	8.2	2.0

In nitrate nitrogen studies, replicate samples must be taken and the significance of small differences discounted. Some investigators claim that the soil should be sampled to a depth of 2 to 3 feet at weekly intervals to obtain reliable data. While this sampling was done only at monthly intervals, it is apparent that a study of the curves and data will afford the basis for a logical use of nitrogenous fertiliser and the obtaining of higher efficiency in orchard management.

A study of the fluctuations observed in this investigation suggests that there is a minimum concentration of nitrate nitrogen in the soil, below which figures are seldom obtained. This appears to be in the neighbourhood of 1 to 1.5 parts per million of "nitrate" nitrogen in the dry soil, considered to a depth of 30 inches and, at this concentration, the fraction will often contain a considerable proportion of water soluble ammonia. The virgin forest soil appears to remain at or near this

minimum throughout the season and the soils of the apple orchard attain it only during the period of winter dormancy and leaching and in the early spring when the trees and cover crop make their heaviest demands on the soil. As regards *quantity* of "nitrate" nitrogen in the soil, this minimum amounts to from 10 to 15 lbs. of nitrogen per acre 30 inches deep, which is equivalent to from 50 to 75 lbs. of sulphate of ammonia per acre. It is felt that this minimum should always be exceeded in a cropped soil during the period of active growth. The figures obtained from the young orchard during October, November and December, when the trees were making very vigorous growth, suggest that, if the soil is maintained at a minimum of 3 parts per million of nitrate nitrogen in the soil, or about 30 lbs. of nitrate nitrogen (equivalent to about 140 lbs. of sulphate of ammonia) per acre 30 inches, the trees will make vigorous growth. Whether a higher level, as maintained in the old orchard, largely by the addition of sulphate of ammonia fertiliser, is beneficial to the growth and yield of the trees, cannot at present be decided. It is felt that there is a distinct limit to the economic level at which the nitrate nitrogen concentration in the soil can be maintained.

Nitrogenous fertiliser augments the water soluble nitrogen fraction and may be detected by analysis. It would seem futile and wasteful, therefore, to use nitrogenous fertiliser when the soil is rich in nitrate or when it is certain to be lost in the drainage water. Furthermore, ammonium salts generally depress the growth of clovers and leguminous plants and do not promote the organic matter accumulation in the soil "humus" or offset the destructive effects of clean, summer cultivation on the soil organic matter. Orchard management must be directed to a very vigorous green manuring programme and the green manure crop must include a vigorous legume. Autumn fertilisation with superphosphate and, perhaps, potash is advised to promote the growth of the cover crop. Nitrogen fertiliser at the commencement of the rainy season will give a temporary stimulation particularly to the non-leguminous plants, but will soon be lost in the drainage system. Nitrogen is, therefore, best applied in early spring.

It seems unlikely that any attempt to maintain a high content of nitrate nitrogen in the soil throughout the winter months will be either desirable or practicable. Little is known concerning the root activities of fruit trees during dormancy, but it is unlikely that there is need for large supplies of nitrogen in the soil at that time.

Where ammonium compounds are used as fertilisers, care must be taken to maintain the lime status of the soil. Nitrogenous fertilisers in this State are generally in the form of sulphate of ammonia. Presuming that all of the nitrogen is absorbed by the plant, sulphuric acid is the residue from the use of this fertiliser. Every hundredweight of commercial sulphate of ammonia contains the equivalent of 81 pounds of sulphuric acid, capable of dissolving 46 pounds of lime (CaO). While there seems no immediate danger on the Argyll soils studied, sulphate of ammonia must always be used with care on account of its action on the acidity and lime reserves of the soil.

It is encouraging that these soils exhibit considerable powers of nitrate formation. This reflects the fertility of the soils, as there is a general correlation between nitrate production and crop production. The figures for phosphoric oxide in the old orchard indicate that the superphosphate applications over a period of 22 years have led to enrichment of the surface soils with respect to phosphate. A high level of fertility is being induced by the system of management employed.

Spring and summer cultivation relieve the trees of competition with weeds, aerate the soil, improve the tilth, and promote plant food formation for the benefit of the crop. It leads to a heavier drain on the capital reserves of the soil, particularly with respect to organic matter and nitrogen, and management must

be arranged to counteract this depletion. Mineral manures alone are inadequate, but used in conjunction with cover crops, which must include a vigorous leguminous plant, the organic matter and nitrogen fractions can be maintained even with the practice of clean summer cultivation. American experience shows that clean cultivation, without organic manures or cover crops in season, lead to soil depletion, stunted trees and reduced crops.

The question of nitrogen fertilisation in the autumn receives light from this investigation. There is a general falling-off in nitrate concentration of the soils during the autumn. This cannot be ascribed to any one factor and is certainly not due to leaching as no soaking rains were recorded. In spite of this falling-off, there seems sufficient present, however, to meet the needs of the orchard prior to the winter rains and dormancy. The fate of the 2 hundredweight of sulphate of ammonia applied to the old apple orchard toward the end of April demonstrates the economic loss of using a soluble nitrogenous fertiliser at this time. A temporary rise in water soluble nitrogen followed this application and was detected in the surface in May. In June, there was no evidence of the added nitrogen in the surface and subsurface layers but it showed very distinctly in the subsoil (see Fig. 2 and Table 9). With the continuance of the winter rains it disappeared from the subsoil which was reduced to a very low level of concentration (0.9 p.p.m. N) by the time of the July sampling. It is considered that much greater benefit would have accrued from the application of this fertiliser at the time of the August ploughing.

The results show a reciprocal relationship between the soil moisture content and the concentration of nitrate nitrogen.

SUMMARY AND CONCLUSIONS.

A general review of the question of nitrogen fertilisation and management is given and mention is made of the new method of attack on the problem of tree culture.

The biological factors in the soil and their role in the production of nitrate are discussed.

An investigation is described in which two soil types, Type A and Type B, of a well managed apple orchard at Argyle, near Donnybrook, Western Australia, were sampled at approximately monthly intervals. Soil type A is a deep river alluvium of a light sandy loam texture showing practically no change in the profile. The orchard on this type is 22 years old and very well grown. Soil type B represents a shallower soil formed on an alluvial fan adjacent to the river alluvium. It has been under apples for a period of 8 years only but is proving very satisfactory, the trees being very vigorous and well grown. The water soluble nitrogen fraction was extracted and analysed by the Devarda reduction method. Generally, this fraction will consist principally of nitrate nitrogen and is referred to as nitrate nitrogen in the tables and figures although it is realised that the water soluble fraction usually contains a small amount of ammonia nitrogen. Certain samples were further examined for total nitrogen, phosphoric oxide (P_2O_5), potash (K_2O), lime (CaO), organic carbon, reaction (pH) and mechanical analysis.

For purposes of comparison soil type B under virgin conditions, under pasture and under fallow, was studied along parallel lines.

The results show that—

1. Soil type A and soil type B are distinct soils chemically and mechanically. They represent good apple soils which are being maintained in a satisfactory state of fertility.

2. Large dressings of superphosphate during 22 years' management under apple orchard conditions have resulted in a substantial accumulation of phosphate in the surface soil.

3. The nitrate nitrogen accumulates in the orchard and pasture soils during the spring and summer. The amount falls off during the autumn and reaches a low minimum during the cold, wet winter months.

4. The soil of the apple orchard, type A, shows a much larger accumulation of nitrate nitrogen during the spring and summer months than does type B in the young orchard. This is in spite of the heavier demands of the larger, heavier yielding trees, and indicates the soil to be at a higher fertility level at present. This may be the result of a longer period of careful orchard management.

5. Deducting the nitrogenous fertiliser application in the spring, the soil of the old apple orchard, type A, to a depth of 30 inches contained 32, 55, 35 and 59 lbs. of nitrate nitrogen for the months of October, November, December, 1933, and January, 1934, respectively. Similarly, the soils of the young orchard, type B, contained 27, 27, 29 and 38 pounds of nitrate nitrogen respectively for the same periods. These figures represent the residual nitrogen after the demands of the crops have been met. From these data it is postulated that a soil maintained at about 30 pounds of nitrate nitrogen per acre 30 inches deep will be able to supply the needs of the apple trees for nitrogen. This is equivalent to about 140 pounds of sulphate of ammonia per acre and represents a concentration of a little over 3 parts per million of nitrate nitrogen on the dry soil basis.

6. The use of large quantities of sulphate of ammonia when the soil is already well supplied with available nitrogen seems economically wasteful. Early spring, when the soil processes are still slow, is the best time to apply nitrogenous fertilisers.

7. Autumn applications of sulphate of ammonia are likely to depress the growth of legumes in the cover crop and a considerable proportion is certain to be lost by leaching with the incidence of the heavy winter rains. Autumn applications cannot be recommended.

8. These soils are on the low side with respect to total nitrogen and contain only medium amounts of organic matter. No effort should be spared to maintain and even improve the total nitrogen and organic matter status of these soils as destruction is very rapid under the system of clean, summer cultivation. It is suggested that cover crops including a vigorous legume should be grown each year.

9. The soils under pasture were subject to less marked fluctuations than those under orchard treatment. Generally, there was slightly more nitrate nitrogen in the soil of the same type under pasture than in the orchard.

10. The fallowed soil was richer in nitrate nitrogen than the pasture or orchard soils. The fluctuations observed are difficult to explain at present.

11. In the virgin forest a minimum concentration of nitrate nitrogen was recorded throughout the year. Apparently the virgin forest with its undergrowth had adapted itself to absorb practically all of the available nitrogen and maintains a minimum concentration in the soil.

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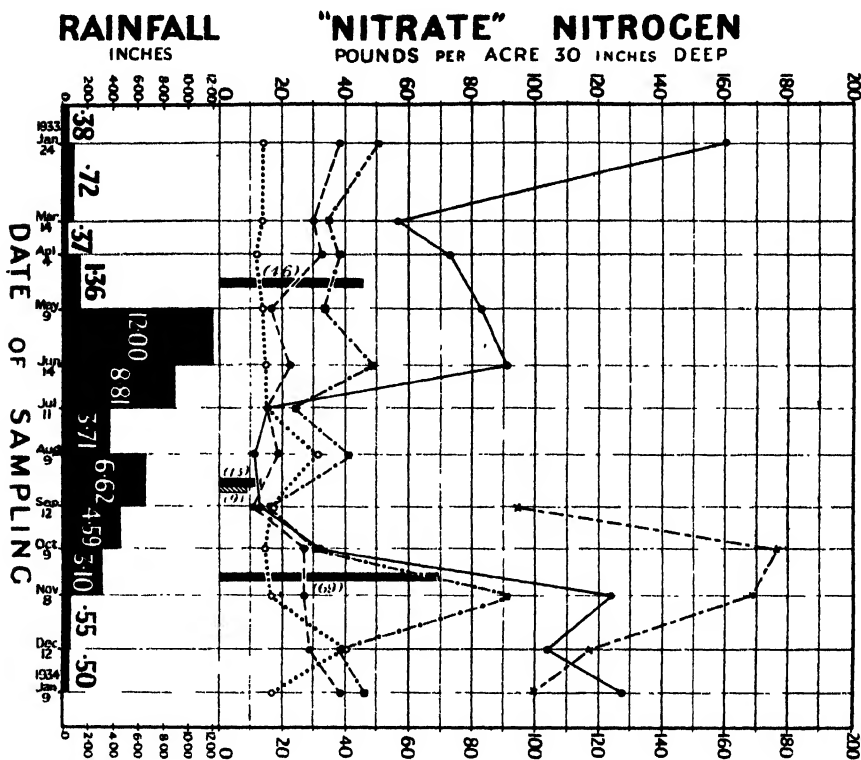


FIGURE 1

Showing distribution of the RAINFALL and AMOUNTS of "NITRATE" NITROGEN (principally Nitrate and Ammonia) in two types of SOIL at ARCYLE (a) in the APPLE ORCHARD (b) under PASTURE (c) under FALLOW (d) in the VIRGIN FOREST expressed as POUNDS of NITROGEN per ACRE of SOIL 30 inches deep for the Season - January 1933 to January 1934.

LEGEND

SOIL TYPE A

APPLE ORCHARD

SOIL TYPE B

APPLE ORCHARD

PASTURE

FALLOW

VIRGIN FOREST

NITROGEN x 47 = SULPHATE of AMMONIA

NITROGEN applied as SULPHATE of AMMONIA FERTILISER to the APPLE ORCHARD TYPE B

A ■ B □

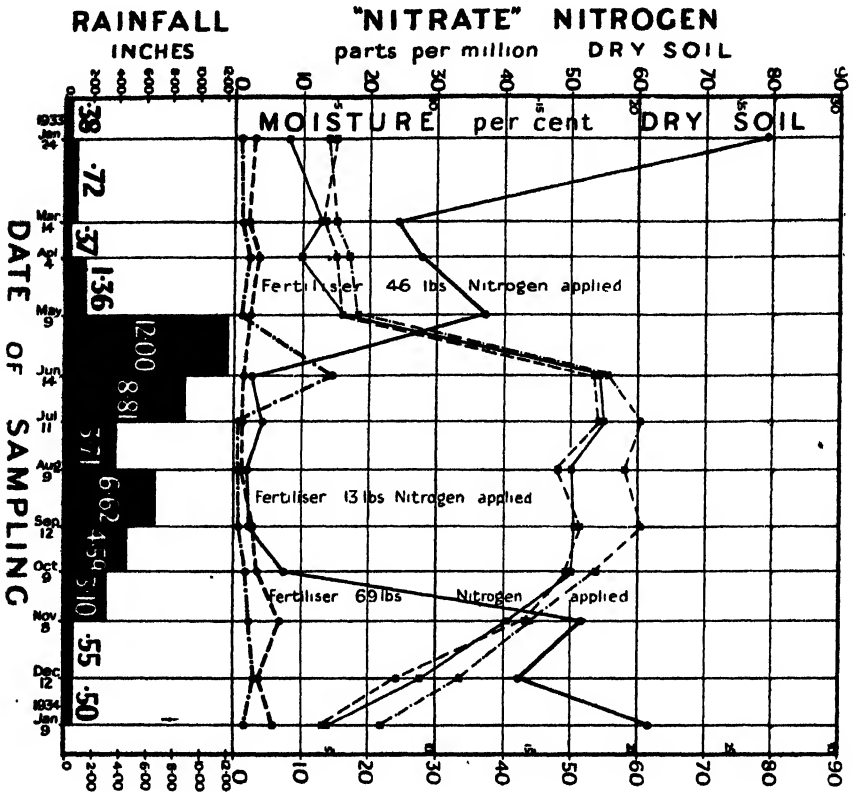
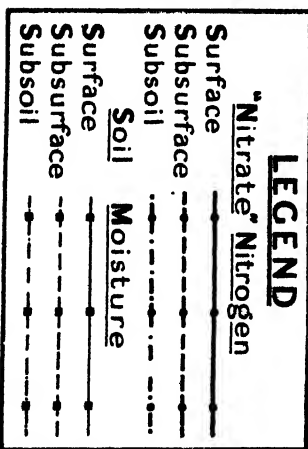


FIGURE 2
TYPE A APPLE ORCHARD

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARGYLE January 1933 to January 1934



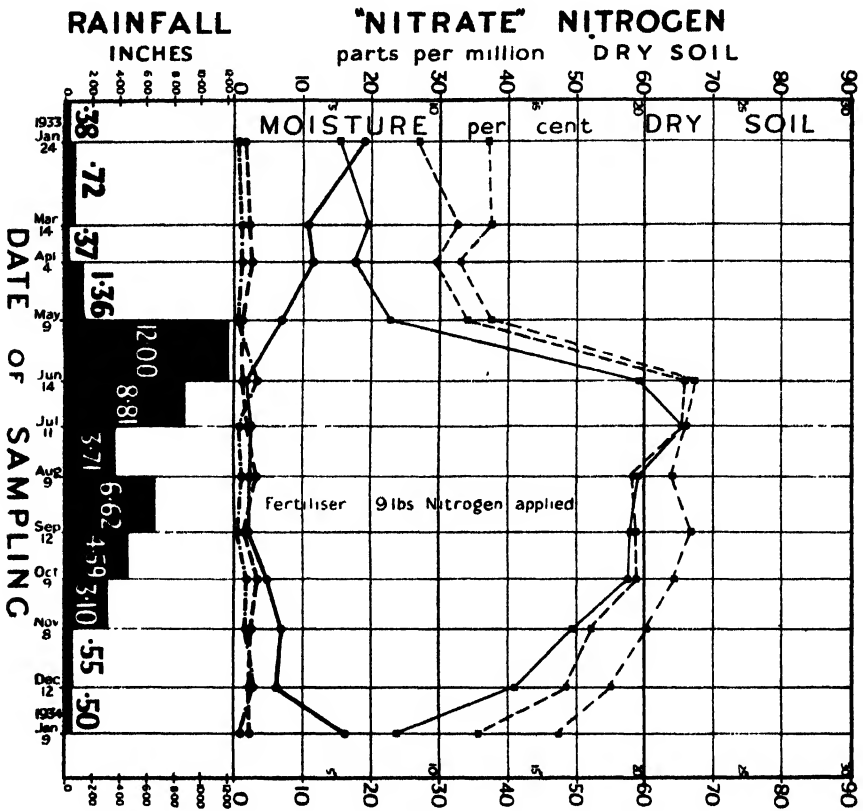
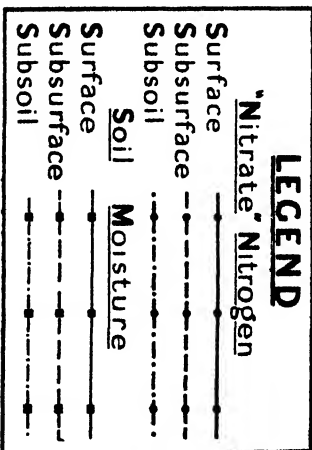


FIGURE 3
TYPE B APPLE ORCHARD

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARCYLE January 1933 to January 1934



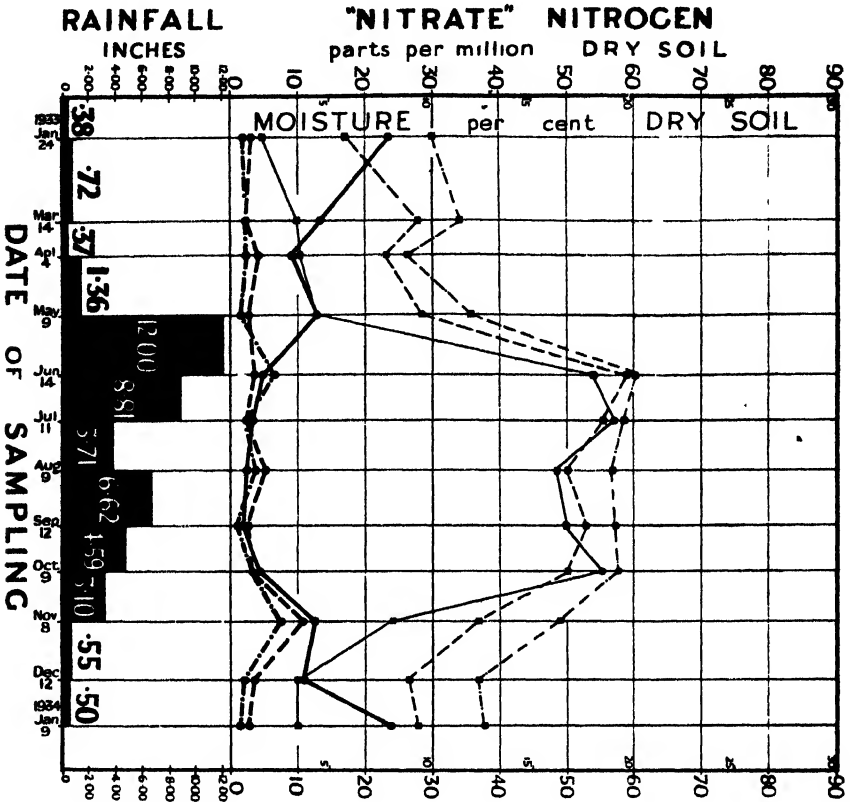
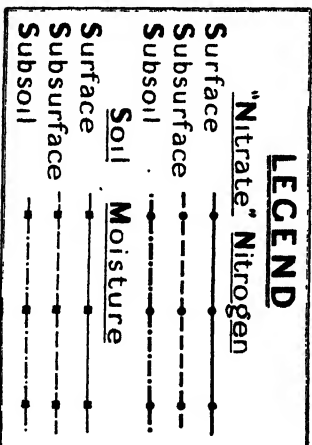


FIGURE 4

TYPE B. PASTURE

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARCYLE January 1933 to January 1934



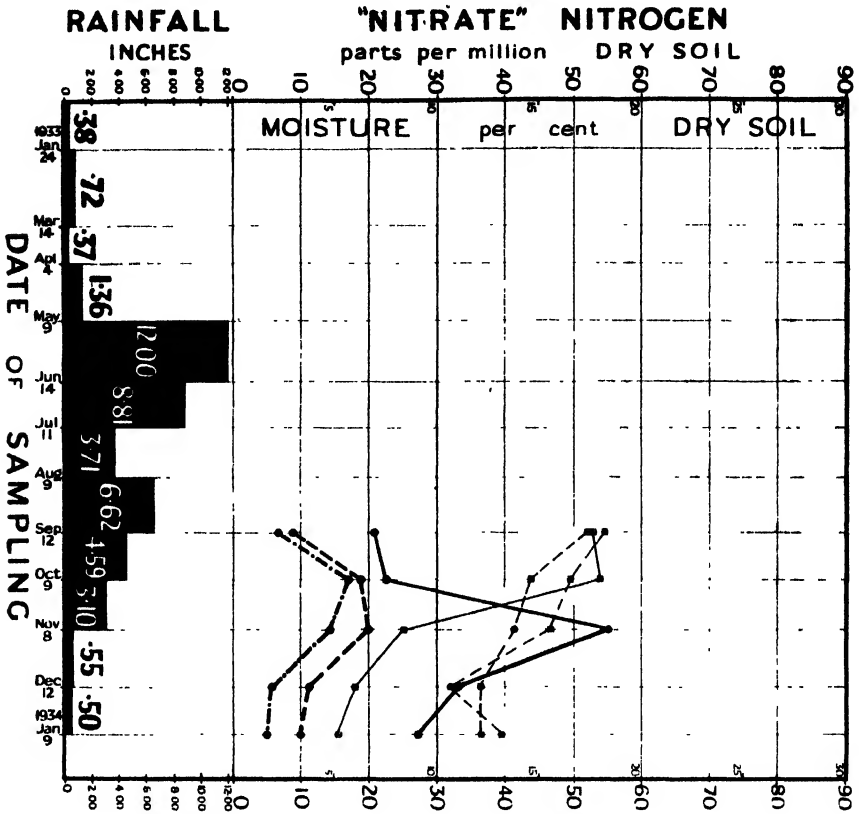
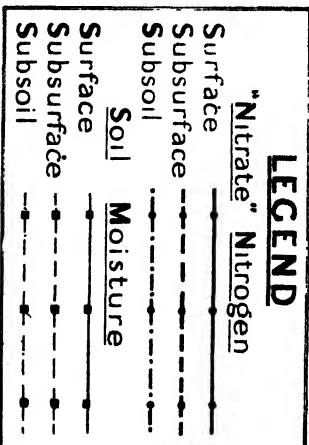
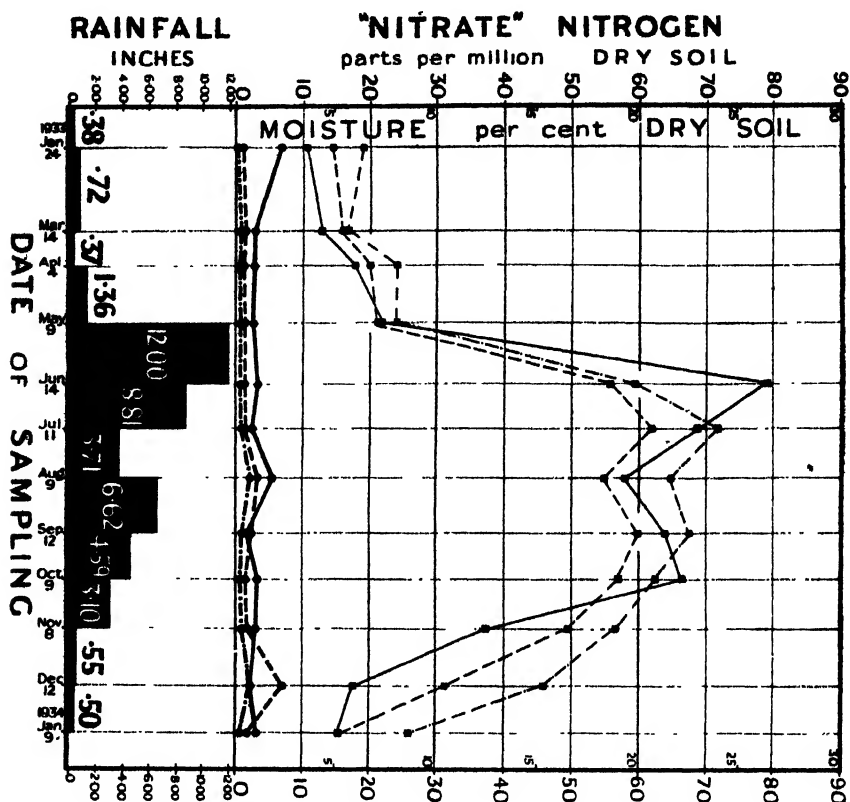


FIGURE 5

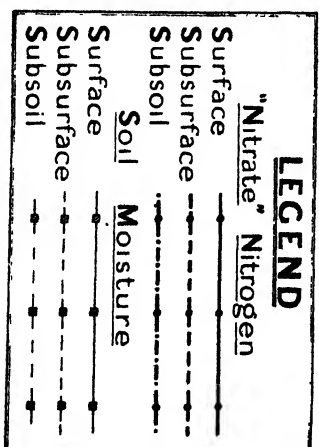
TYPE B FALLOW

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARCYLE January 1933 to January 1934



**FIGURE 6****TYPE B VIRGIN FOREST**

Showing seasonal fluctuations of "NITRATE" NITROGEN (principally nitrate with a little ammonia) and SOIL MOISTURE in the SURFACE, SUBSURFACE and SUBSOIL layers in relation to RAINFALL at ARCYLE January 1933 to January 1934



ENTOMOLOGICAL PROBLEMS.

THE INTRODUCTION, INCREASE AND CONTROL OF VARIOUS INSECT PESTS.

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Prior to the year 1890, when the gold rush to Western Australia took place, but slight attention had been given to the agricultural and horticultural possibilities of this State. With the great increase of population which followed the discovery of gold, new towns came into existence. This created a demand for foodstuffs, far beyond the powers of production of the then agriculturists and suggested the possibility of utilising the State's lands to a greater extent. It was soon proved that most of the produce required could be grown within the State, and with this awakening, there arose the need for guidance in the protection of crops against the numerous insect pests.

The country in its original state, did not carry plants and animals suited to the requirements of the white man, which meant that almost everything required for our race had to be introduced. With these early introductions, many serious pests of plants and animals were unfortunately brought to our shores and became established pests. We cannot blame our forbears, as they were struggling against great odds and ignorant of the noxious nature of many of the insects, plants and animals they introduced. One cannot help, however, regretting the great opportunity of preventing the introduction of these pests that was then lost. If the rigid quarantine, associated with modern administration, had then been operative, we would now be enjoying a wonderful degree of freedom from a large number of the pests that take such a heavy annual toll of our produce. The activities of injurious insects, which furnish the problems of applied entomology, are always more pronounced in countries where, for various reasons, the stability of the physical or biological environment is changed.

One of the chief causes affecting the stability of the environment, and consequently the activities of the insects introduced in such countries as Western Australia, is the extension and development of large agricultural and pastoral areas. This not only modifies the natural environmental conditions of native insects, but the replacement of the natural flora by introduced plants has placed the insects, tortuously brought in from other lands, in new surroundings.

In many instances the destructive insects so introduced have established themselves under conditions of climate more suited to their rapid development than in the country of their origin, and minus their natural enemies. Under such conditions there is always the possibility of an insect becoming a very serious pest. Any disturbance of the "balance of nature" always brings its penalties. As an instance of the various species of aphids found infesting our gardens, not one is native to Australia, and it is now realised that the control of aphids constitutes a very serious problem. The same may be said of the scales infesting orchards and gardens; there is no instance of a native scale seriously attacking fruit trees or garden plants. This affords the answer to a question so often asked as to why entomologists are faced with more problems in newer agricultural and horticultural countries than in older settled countries. To mitigate the great damage that can be caused by insects, the farmer, orchardist and pastoralist are dependent upon expert advice. This demand led to the formation of the Bureau of Agriculture in 1894, and in the year 1899 it was advanced to the status of a Department.

FRUIT FLY

(Ceratitis capitata).

The first problem which called for special research was the Fruit Fly. This serious pest was introduced some forty years ago from Southern Europe, per medium of imported citrus fruits, before sufficient citrus fruits for our local requirements were being produced.

The pest was first recorded in Guildford, but, unfortunately, there was no entomologist to advise upon the nature of the insect or the action to take for its eradication or control. Consequently, the pest soon became widespread around Perth. Had its potential powers as a fruit destroying insect then been recognised, it could have been eradicated, but to-day it is permanently established in our West Coastal plains, and spreads each summer into many of the Darling Range orchards. It is a most insidious and difficult pest to deal with.

The first efforts towards control were made along biological lines. Mr. Compere, Entomologist to the Department at that time, was commissioned to search various parts of the world for natural enemies, and parasites of various other related species of fruit flies were obtained and forwarded to this State. It was the duty of the writer to breed up these parasites, destroying all secondaries and liberating only the primaries in the orchards. Myriads of parasites were thus reared and distributed. Unfortunately, up to date negative results have to be recorded, and no effective natural control of the Mediterranean Fruit Fly has yet been discovered.

In passing, it is worthy of note that Western Australia was the first State in the Commonwealth to undertake or attempt biological control of insects.

The life history of this fly was worked out as it occurs in Western Australia, proving that there is a complete generation every 34 days from mid-October to mid-April, and that the main carry-over during the winter (May to September) is per medium of over-wintering flies.

The discovery that the male fly exhibited a peculiar chemotropic reaction to kerosene, when used as a lure, encouraged continued research along these lines. It was then discovered that pollard and water was very attractive to the female fruit fly, and this resulted in the issue of the pollard, bran and water formula, which is still recommended by the Department of Agriculture. Work was continued, and more recently Clensel, a proprietary liquid soap, has been found a very excellent lure. A fruit juice poison bait was also evolved.

Full particulars in regard to the methods of poisoning or luring the fruit fly can be obtained from the Department of Agriculture. It must be remembered that the successful control of this pest can only be accomplished by the active co-operation of all-concerned.

BLACK SCALE

(Saissetia oleae).

The Black Scale was at one time one of the most destructive scale insects. It attacked citrus and many deciduous fruit trees and numerous garden plants. Biological control of this pest was undertaken with very positive results, as several body and egg parasites were successfully introduced from various parts of the world. Some of these parasites are now well established and have resulted in the restoration of the balance of nature. To-day this scale is, generally speaking, of little consequence in Western Australia. In work of this nature, great care has to be exercised to prevent the introduction of secondary parasites, as any mistake in this regard would permanently nullify the effectiveness of the primary parasite.

CABBAGE APHIS AND CABBAGE MOTH

(*Aphis brassicae* and *Plutella cruciferarum*).

These two insects (the former a sap sucker, the latter a chewing insect), at one time rendered it almost impossible to successfully grow payable crops of cabbage, cauliflower or turnips. To-day the position is greatly improved by the introduction of parasites from the Orient, which help in a great measure to keep down these pests. Artificial methods have also been advised. Owing to the dry weather experienced during the summer months, which favours the increase of the Cabbage Moth caterpillar, considerable damage is sometimes experienced in the autumn crop, but if the crop is kept growing vigorously and the recommended remedial measures applied, the difficulty can be overcome.

THE MEALY BUG

(*Detylopius* sp.).

The above ground form of the Mealy Bug, in citrus orchards, was at one time a very destructive pest. It has been brought below the danger line by the successful introduction of the Queensland Ladybird (*Cryptolameus montrouzieri*).

PLAGUE LOCUST

(*Chortoicetes terminifera*).

This is one of the few native insects which were very troublesome in the early stages of wheat farming in North-Eastern and Eastern wheat areas.

The trouble was brought about by the clearing of the natural forest belts in preparing the land for wheat growing. The timber belts acted as natural barriers, which kept the locusts more or less localised. A careful life history study of the locust was made and it was found that the eggs were laid in October-November into bare hard land, such as stubble, non-grassy country, roadsides, etc. These eggs hatched in July into tiny hoppers, which reached the adult winged stage in six to eight weeks. Methods of control were tested and it was demonstrated that the plague locust could be prevented by the systematic shallow ploughing of all areas where the eggs have been laid, as the eggs are thus exposed to the elements and predatory enemies. Where this can not be successfully done, the use of a poisoned bran bait, applied to the hoppers, is found to be very effective.

By the adoption of these measures co-operatively, the locust can be controlled. The danger now facing the farming community arises from abandoned farms; in these unattended areas the locusts are again breeding up, and sooner or later will reach plague form and cause great economic losses.

THE ARMY-WORM AND WEB-WORM

(*Persectania ewingii* and *Sclerobia tritialis*).

These, like the locusts, caused a good deal of loss in the initial stages of farming, but it has been proved that by good farming methods, such as clean fallow, early ploughing and poison baiting, that the caterpillars of both these moths can be successfully combated. Late sowing in weedy or grassy land, or on stubble, is courting trouble from these insects.

BLOW-FLIES—VARIOUS.

There is no doubt that the blowfly problem amongst sheep is one of the most serious insect problems.

In spite of all efforts such as crutching, dipping and jetting, very great numbers of sheep are annually lost to the State through attack by one or other of the primary blowflies.

In an effort to obtain knowledge regarding the seasonal and regional distribution of the blowflies and the species responsible for the damage, a trapping survey of the South-West was made, which revealed the presence of four primary blowflies. The discovery of the fourth species is the result of recent research. This is the Bluebottle fly known as *Lucilia cuprina*, the most active primary blowfly of the Eastern States.

Every effort to control blowflies by biological means has been made. Several species of parasites have been introduced from other countries and distributed in large numbers, but the testing of this method has forced the conclusion that there is little hope of success along biological lines.

In further studying this problem we have evolved a blowfly trap, commonly known as the West Australian blowfly trap, which has been tested against all other types of traps and has proved the most effective. Trapping methods are being officially tested both in this and the Eastern States, but results have not yet been finalised. Considerable testing with fly repellents has been done, but so far no specific used on sheep has given any lengthy period of immunity from fly strike. It is now considered that much of the trouble from blowfly strike of sheep is due to the breeding of susceptible types, and that to overcome this the susceptible sheep, those that are badly wrinkled about the breech, will have to be eliminated from our flocks.

THE LUCERNE FLEA

or, as it is now being called,

THE CLOVER SPRINGTAIL.

(*Sminthurus viridis*).

This was first discovered in the State in 1915 following the drought year of 1914, during which year large quantities of lucerne hay were imported from South Australia. The Clover Springtail has been known in that State for over forty years and it is therefore thought that it was per medium of this hay that the pest was introduced to this State. The flea rapidly spread and is now found established in almost every part of the South-West having a rainfall of 16 inches or over. Fortunately it is confined to the soils of a colloidal nature and which have a surface of decomposed organic matter, with good moisture-holding capacity: it is never found on sandy light dry lands. It is purely a wet season insect, making its appearance 10 to 12 days after the first general autumn rains, the young issuing from aestivating or over-summering eggs laid in the late spring. These eggs, which are laid on the surface of the ground in cracks and crevices in the soil, withstand the heat and dryness of the summer, remaining practically dormant for six months.

It is most unfortunate that coinciding with the spread of subterranean clover this pest was introduced. The insect has taken advantage of the feast spread for it in the shape of subterranean clover.

Experimental work to destroy the Springtails per medium of poison dusts and sprays was carried out, but there were many negative results. The outstanding success was from the use of a lime-sulphur spray at a strength of 1 part of the mixture to 60 parts of water—a spray which destroys both by contact and ingestion. It is non-poisonous, and cattle readily feed over pasture thus treated.

Unfortunately, as the pest is so widespread, the use over large areas of any artificial treatment is not economically possible, but in small areas such as lucerne plots, etc., control can be had by the use of the lime-sulphur spray.

Early spring fallowing will destroy the pest before the over-summering eggs have been laid, and autumn ploughing after the eggs have hatched is also an effectual check. Slow-burning fires will destroy large numbers of eggs. Agrostological work is now being done with the object of selecting strains of clover and other suitable fodder grasses unpalatable to the flea.

During research work in the field, a parasite mite, commonly known as the Bdellid Mite, was discovered. This mite is of European origin, as is the Clover Springtail, and there are grounds for believing that this predator will prove a definite controlling factor. The collection and distribution of this mite is being undertaken. It has now been successfully colonised in several areas, and it is intended to continue the work of distribution. Unfortunately, it cannot be bred up in cages, hence it has to be collected in the field, which is slow work. Colonies have also been forwarded to South Australia, Victoria and Tasmania.

THE RED-LEGGED EARTH MITE.

This is undoubtedly the most difficult of all our pasture problems. It is not a true insect, being one of the non-web-spinning mites.

Like the Clover Springtail, it is a wet-season pest, also producing an over-summering egg which carries over the dry season from spring to autumn. It is more widespread than the Springtail, being found inhabiting all types of soils and extending its range to the extremes of the wheat-belt and thriving in as low a rainfall as 10 inches. First recorded in this State from Bunbury district in 1920, it is also found in all the Eastern States, except Queensland. Its food habits are more cosmopolitan than the Clover Springtail, but like this insect it is very partial to clovers and other legumes.

The cultural methods, as employed against the Springtail, are effective. In small areas it can be controlled by the use of sprays or dusts having a carbolic content, and dusting with naphthalene is also effective. Considerable search has been made both here and in other parts of the world for controlling parasites, but so far with negative results. Agrostological research is also being employed to find mite-resisting fodder plants and grasses.

THE APPLE WOOLLY APHIS.

For some time this was a most serious pest of apple trees until in 1925 the successful introduction and establishment of a very effective internal parasite of this aphid, *Aphelinu smali*, was effected. In connection with this pest a tribute should be paid to the late Mr. W. Grasby for his great interest and kindness in permitting the use of his garden, under quarantine, for the purpose of establishing this beneficial wasp. To-day the spray pump in most instances is not required for the control of Woolly Aphis, the parasite doing the control free of cost to the growers.

CODLIN MOTH

(*Cydia pomonella*).

It is pleasing to be able to state that, although there have been eleven outbreaks of this very serious pip-fruit pest, the State to-day is clean. This happy result, which means so much to the apple and pear export business, has been brought about by the hearty co-operation of fruit growers with the Department of Agriculture.

GREEN TOMATO BUG

(*Nezara viridula*).

This is a pest of more recent introduction and is very difficult to control. Being a sap-sucking insect, it can only be controlled by contact spraying and complete

farm sanitation. Efforts have been made to introduce various parasites which are known to exist in Florida and Egypt. An account of this work is given in leaflet No. 179.

BUFFALO FLY

(*Lyperosia exigua*).

The Buffalo Fly is a small blood-sucking fly. Every reasonable effort is being made to confine this pest to those areas in the North-West where it has become established. Parasites from Java have been introduced by the Federal Entomological Department, and it is hoped these will become established and prove a natural check.

THRIPS

(*Thrips imaginis*).

During recent years a native flower thrip has assumed the role of a very serious apple and pear pest, although its depredations are by no means confined to these fruits, many kinds of garden flowers being also seriously attacked. This pest is at present the subject of investigations both here and in the Eastern States. Two entomologists and a chemist are working at the problem under Dr. Davidson, Entomologist, at the Waite Institute, Adelaide.

When this pest appears in plague form at the time of apple blossoming it ruins the bloom, resulting in a non-setting of fruits. Fortunately, this does not happen every year.

There is, however, a potential plague every year should the blooming of the apples synchronise with a rise in the soil temperature, due to a spell of early warm weather.

The chief native host plant of this thrip is found to be the common yellow prickly Mimosa. Every effort is being made to discover, if possible, some effective repellent spray that can be applied as the flower buds begin to show colour; there are no known effective parasites of this insect.

Thrips are very soft-bodied insects and in gardens can be checked by the use of contact sprays.

“THE JOURNAL OF AGRICULTURE”

will be supplied free *on application* to any person in the State who is following Agricultural, Horticultural, or Viticultural pursuits, and to Agricultural Societies or Associations.

A charge of One shilling and threepence per copy will be made for the *Journal* to persons other than the foregoing, or who do not reside in the State. These applications, accompanied by the requisite amount, must be forwarded to the Director of Agriculture, Department of Agriculture, who will also receive all correspondence dealing with the conduct of the *Journal*.

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If you are not receiving the *Journal*, which is issued quarterly, and wish to do so, please forward your name and postal address to the Director of Agriculture, Perth.

ROYAL AGRICULTURAL SOCIETY.**SUMMER FODDER CROP COMPETITION.**

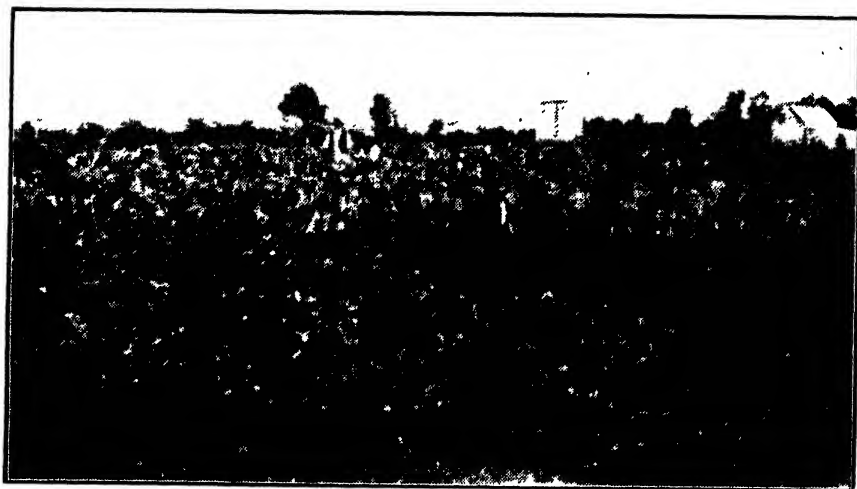
H. G. ELLIOTT,

Agricultural Adviser, Dairy Branch.

The Summer Fodder Crop Competition was continued during the season 1934, being conducted by the Royal Agricultural Society.

Judging was carried out by W. Ireland, Dairy Supervisor, Manjimup, and H. G. Elliott, Agricultural Adviser, Dairy Branch.

Owing to the continued dry season, the summer fodder crops outside the irrigation areas were generally poor, but the results obtained by competitors show the value of thorough cultivation.



The accompanying illustration shows a portion of a one-acre stand of marrow-stemmed kale grown by Mr. Candy, of Forrest Hill, Mt. Barker. This crop was estimated to yield in the vicinity of 30 tons of green material per acre.

The particulars of the points gained, and the methods of cultivation adopted by the competitors, are shown in the following tables:—

Competitor.	Yield 50	Evenness of Growth 10	Freedom from Weeds 15	Cultivation 15	Freedom from Disease 10	Total 100
H. Brown, Manjimup.	47	9	11	12	10	89
C. Candy, Mt. Barker.	28	9	15	15	9	76
F. S. Morris, Harvey.	35	8	11	11	9	74
H. J. Jav, Yanmah.	36	7	10	10	9	72

The following are particulars regarding the methods of cultivation, fertiliser, etc.:—

	H. Brown.	C. Candy.	F. S. Morris.	H. J. Jay.
Date Weight taken ...	20-4-34	26-2-34	5-2-34	16-3-34
Drills apart ...	24 inches	72 inches	27 inches	24 inches
Average height ...	3ft. to 14ft.	7ft to 8½ft.	7ft. to 7½ft.	3ft. to 14ft.
Fertiliser—Rate per acre	No. 3 Potato Manure: 300lb. per acre	Super and Ammonia No. 2: 250 lb. per acre	"(" Potato Manure: ½-ton per acre	4 parts Super 1 Sulph. Ammonia, ½ Sulph. Potash at rate 400 lb. per acre
Soil ...	Sandy loam	Grey to red loam, slightly gravelly	Grey to chocolate loam with gravel ridges	Sandy
Rate of Seeding ...	Maize 25 lb.	Maize 28 lb., Kale 24 oz.	Maize 40 lb.	Maize 40 lb.
Date of Seeding ...	12th and 26 January	14th and 28th November	24th October onwards	3rd December onwards
Germination ...	...	90 per cent.	80 to 95 per cent.	...
Estimated weight per acre (tons)	28·05	11·02	21·21	21·61
Area ...	...	3 acres	3½ acres	...
Cultivation ...	...	Twice ploughed, cross harrowed and rolled	Twice ploughed, harrowed and rolled	...

THE POULTRY FARMERS' TRINITY.

"BREEDING," "WEEDING," "FEEDING."

G. D. SHAW,

Poultry Adviser, Department of Agriculture.

West Australian poultry farmers are realising how very necessary it is to lower the cost of production. Formerly it was not considered essential to apply science to the breeding, etc., of fowls for eggs or flesh, but now more and more poultry farmers are turning to science to aid them with their problems.

BREEDING.

For some considerable time, breeders of blood stock have considered it necessary to study breeding lines, and have each year developed those lines to a well thought out plan to attain their objective.

Good breeders are persistently endeavouring to combine size, shape, egg production, and colour in a bird which will be pleasing to the eye, while at the same time returning a high profit whether it be from eggs or flesh. Only those who are prepared to study and apply scientific knowledge of breeding in order to obtain that ideal can hope to succeed in the race for cheap production and a substantial profit.

The poultry farmers' trinity should be "Breeding," "Weeding," and "Feeding." Breed the best, weed out all but the best, and feed the best properly.

Fowls are classified into breeds by their shape and plumage, and no matter how good a bird's plumage, unless it conforms to the typical shape of its breed, it should not be placed in a breeding pen. By consistently breeding from shapely birds, breeders standardise their breed. Such shape embodying length, width, and depth defines "type." Unless a bird conforms to its breed type, discard it.

Western Australia has in the past concentrated on Australorps and White Leghorns, but of recent years Rhode Island Reds are beginning to make progress as utility birds. Only by the strict adherence to the type required for the Austra-

lorp breed, will breeders produce birds rising to the capabilities of Australorps. The same applies to all breeds whether for eggs or flesh.

One might be pardoned for suggesting that very few who hatch chicks from their own stock understand the type of the breed they are keeping, but such is unfortunately the case. "A breeding pen consists of one cock or cockerel mated to 8 to 12 hens according to heavy or light breeds." By accepting that bald sentence the poultry industry has caused itself untold difficulty and financial loss.

Realise early that the cock or cockerel must be the best bird of its breed obtainable. He must have all the capabilities of a sire able to produce his like, and whose progeny will so develop as to be capable of reproducing a flock of birds equal to, if not better than, the original sire.

The hens should be uniform and according to type, and they also must be able to reproduce stock which conforms to the ideal. Frequently there is the temptation to use a hen whose only claim to a place in the breeding pen has been high egg production, but it is better to discard the record layer which fails in type and substitute a hen combining type and vitality with egg-laying capacity even though the number of eggs laid is far less than the production of the record breaker.

A few breeding pens of select stock will pay better than trying to breed from numbers of birds, many of which cannot reproduce progeny of "type."

Type has been developed by those who have scientifically concentrated on all the points essential to maximum production, and by concentrating on type, those breeders will produce more profitable birds than breeders whose practice has been to use the high producer no matter what faults may be present.

When selecting breeding pens, select a cock or cockerel which conforms as nearly as possible to the type of his particular breed and whose mother had a good production of large eggs. He should be full of vitality and "boss" of the farm. The hens should show vitality and type and be producers of many large eggs.

If both sexes are birds of type and vitality, the matings will result in easily hatched and reared chicks, a large proportion of which will develop into birds typical of the breed and of good average egg production.

WEEDING.

No matter how good the breeding pen, the resultant flock will always carry birds which are not typical of their breed, lack vitality, are undersized, and not good "doers." To weed out those unprofitable birds is as important to successful poultry farming as strict attention to the breeding pens. It would not be out of place to say that weeding or "culling" (its common name) is not practised in Western Australia as it should be, partly through lack of confidence in ability to discriminate, but more through ignorance of its necessity.

From the time the eggs chip, the poultry farmer should rigidly cull his flock.

A weakly chick should be killed, chicks which fall behind in the race to maturity should be eliminated, and any that do not fill the requirements of type should not be tolerated.

Right throughout the bird's life, it should be continually subject to a search for faults, which, having been found, should cause the discard of the bird.

Constantly handle the birds. This helps poultry farmers to compare the best with the worst and teaches the breeder the faults in mating.

Rigid culling keeps down the feed bill and also allows of more time being spent on those birds which make the farm profitable. It is better to have 500 fowls all producing at a profit than 1,000 birds, 400 of which are not earning their feed. Complaints of poultry farming not paying generally indicate that the farmer does not cull his flock.

With a little practice the efficient culling of the "waster" is easily attained. Look for the prominent eyes, alert action, clean face, long and deep body, wide back, balanced carriage, and a general air of business. Then keep on handling.

Continuous handling provides comparisons, and with practice and careful observations the poultry farmer will generally be unconsciously classing his birds as "good," "medium," or "bad." For a start, put the "medium" and "bad" in separate yards for a period to confirm the opinion.

When the farmer is practised, the necessity of confirmation is not required, and the indifferent producer is marketed early. Feeding is lightened, time is saved, and the space so vacated used by profitable stock.

If trap nests are used, the culling is easy and sure, and no farmer who operates trap nests should ever be carrying a "passenger."

FEEDING.

Having satisfied oneself that all the birds now on the farm are profitable, correct feeding must be observed.

The pedigree of a bird is governed by the quality and quantity of the food the bird eats and *digests*.

Many farms are stocked with birds which are starving amidst plenty because they are not receiving a balanced ration. The right proportion of proteins to carbohydrates is not being fed.

Science and its application has proved that to obtain the best from all stock it is necessary to feed an easily digestible ration composed of constituents which should keep the stock in an athletic condition and allow the birds a surplus to make eggs.

The balance is 1 of protein to 4.5 or 4.8 carbohydrates and fats. If the ratio is less than 1:4.5 it is termed "narrow." If greater than 1:5 it is called "wide."

The blending of the available feeds in such a way as will ensure tissue building and eggs can easily be accomplished by the intelligent application of science.

The practice in Western Australia is to feed a mash in the morning with wheat as an evening grain.

The mash is "narrow," *i.e.*, is constituted of ingredients which have a high proportion of protein. The wheat is "wide" (high in carbohydrates and fats). One must feed only sufficient mash and wheat in right proportions in order that the medium between "narrow" or "wide" is obtained.

If the ration quantities are rigidly adhered to without taking into consideration the condition of the birds, the balance is upset and more harm than good is done.

It is readily understood that at certain periods of the year birds (like humans) do not "feel like eating," and so both morning and evening meals should be reduced in proportion—not one or the other alone drastically cut down.

Many poultry farmers will agree that the practice is to feed about 5 p.m. The farmer is tired, so are his attendants. A yard of 150 fowls *should* eat two gallons of wheat, and so that yard is given its quota and forgotten until next

morning, when the mash is taken round. A large portion of the mash is left and collected at various periods after feeding and given to the birds, say, at noon. At night the wheat is again given and again forgotten until one finds that the mash is nearly all left. The birds go off the lay and the egg basket stays empty.

By feeding the wheat an hour earlier and by rationing it out to each flock, one can gauge whether the birds are hungry. If they do not approach the attendant eagerly only a small portion of wheat should be given and supplemented until they are satisfied, but never more than 2 ozs. per bird. If half the normal quantity satisfies their hunger, the farmer is saving money directly and also ensuring that the birds will be ready for their morning mash. If any wheat is left on the ground or in the litter, the birds consume it in the morning before sunrise, and they are already half fed before the mash is brought to them, so they receive an unbalanced ration by consuming more wheat in proportion to mash.

The whole aim in intelligent feeding is to make the birds consume the right quantity of mash in relation to grain. By doing this the birds are kept in that athletic condition so necessary for egg production.

The mash should be so balanced that the concentrates (bran, pollard or wheat-mal, oilcake, linseed meal, meat meal, bone meal) give a completely satisfying feed of egg producing qualities when fed with the right proportion of wheat. It should also have sufficient bulk in order to allow of complete digestibility of nutrients. The quantities generally given are complete in themselves, and only need the correct application to obtain the maximum results.

Four gallons of mash should be sufficient for 50 to 60 birds, but seven pints of grain is all that is necessary, so it is obvious that after the grain feed the crop is far from full. To satisfy the bird's hunger, always feed chaffed green after a wheat ration.

If birds eat only half the normal quantity of grain, they should require only half the normal quantity of mash, and this principle should be applied until the flock is again consuming its maximum quantity.

THE GLUT PERIOD OF EGG PRODUCTION.

G. D. SHAW, Poultry Adviser, Department of Agriculture.

From August until well into December the fowls will be laying their best and producers are preparing for the export of the surplus.

It is a near-sighted policy to allow the other fellow to export while you reap the benefit of his labours.

From August to December is a busy season on the poultry farm. The hatching season is in full swing at the time export commences and care of the growing chicks consumes the farmer's time until the exporting finishes. Therefore it behoves all to make the work as light as possible, but in endeavouring to lighten work export requirements must still be respected.

Collecting eggs frequently saves cleaning; packing when collected preserves a routine, and frequent marketing ensures quality.

Export during the last few years has increased enormously, indicating that the farmer understands its necessity in order to hold the local market prices and also to introduce as much new money into Western Australia as possible.

The prominent local export firms deal direct with the producers and advance within a few pence of the estimated value of the eggs. They supply cases, fillers,

etc., and attend to all the necessary railing. A Pool is formed of growers consigning through those agents and all participate in the profits. This does not apply with those firms who buy outright. The grower should realise that the outright buyers pay only what is considered will allow of a profit. The pooling system gives that profit back to the grower.

Export is the only salvation of the industry as it is at present constituted. So many farms are carrying birds which will only lay in spring that the market is depressed, so export has come to stay.

When forwarding eggs for export:—

- (1) Brand the case distinctly "For Export."
- (2) Collect eggs at least twice daily.
- (3) Pack only clean eggs. Any egg not clean should be wiped with a damp cloth.
- (4) Store eggs in a cool place free from draughts.
- (5) Market them as often as possible. Seven times a week is not too often.

Number (5) condition must be amplified.

The country producer is the cause of depressed prices in that the greater proportion of his eggs are not marketed properly. This disparity in quality in comparison with metropolitan eggs is being broken down but more is needed. It is a well-known fact that the farmer who comes into town once a week also brings the week's supply of eggs and hands them to the grocer in exchange for cash or kind and, as the farmer's day is usually Saturday, it means that the country storekeeper does not place those eggs on rail until Tuesday at the earliest. They arrive in Perth on Wednesday and are candled and examined on Thursday, about 11 or 12 days after being laid. The result is that very few, if any, are fit for export.

If the producer would only realise that the storekeeper is not going to receive export prices for those eggs, he would understand why only 5d. or 6d. is paid to him.

(6) Pack air cells upwards. This is very important for many eggs packed air cells downwards, when candled, show enlarged cells and are rejected as stale, when they are really fresh.

Above all treat the production of eggs as a business and not as an encumbrance.

(7) During the export season country farmers should deal direct only with export floors with the object of securing the highest returns. This aim is frustrated if producers consign eggs and take goods in exchange. It is common knowledge that if a store has a surplus of eggs that surplus is forwarded to an export floor for disposal, which means that the store is reaping a profit both ways. The store has to take delivery at railhead, sort and then reload for delivery to the export floor. Such handling damages the eggs and the returns are short of expectation with the result that the store can only pay low prices to the producer. In any case, the store is not handling eggs for nothing; the price given must allow of a profit although the store does not handle the sale of the eggs.

By sending direct to export floors the eggs are paid for on quality, and all profits are returned to the producer. No producer should allow a store to trade in his surplus eggs.

Cases can be instanced where the producer has been paid 8d. per dozen and those same eggs were forwarded to an export floor and netted the storekeeper 10½d. to 11d. without any extra handling whatsoever.

Therefore send all eggs produced from July to December to export floors direct and have that 2½d. for yourselves.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1933.

I. THOMAS, Superintendent of Wheat Farms.

Although over the greater part of the Wheat Belt the total rainfall for the conventional growing period (May to October) was about equal to the average, the incidence of the precipitations was not altogether satisfactory.

Following upon the dry summer and autumn the seasonal winter rains did not commence until the beginning of the last week in May. This gave no opportunity for weed destruction prior to seeding some of the crops and, consequently, many of those sown on a dry seed bed suffered considerably from weed competition. Crops planted after the commencement of the rains suffered less in this direction, and in most cases the results were more satisfactory.

The rainfall for May, June and July was above the average, and in some districts trouble was experienced through waterlogging. During September a dry and rather anxious period was experienced. However, the crops withstood this better than might have been expected.

The experience of this season indicated that, when weeds are likely to be troublesome, it is desirable to wait for the rains before seeding. This may entail the planting of suitable early and very early maturing varieties, and farmers would do well to retain a reserve supply of seed of a variety such as "Noongaar" wheat in anticipation of a late opening to the season.

The results of the experiments conducted at the Wongan Hills Light Lands Farm and the Salmon Gums Experiment Farm are given below. The results of the experiments at the Dampawah, Yilgarn, Merredin and Chapman Experiment Farms have been published in the March issue of this Journal.

The superphosphate used throughout the experiments had a phosphoric acid content of 22 per cent.

WONGAN HILLS LIGHT LANDS FARM.

Farm Manager—A. R. Venton.

The monthly rainfall for the year, together with those of 1932, and the average for 20 years, are as follow—

Year.	Jan.	Feb.	Mar.	April.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June	July	Aug.	Sept.	Oct.	Total.			
1933	9	11	10	5	208	389	191	232	81	159	1,200	43	15	1,353
1932	50	13	119	95	292	134	393	554	76	178	1,627	6	24	1,934
Average, 20 years	35	49	88	72	202	274	278	211	125	96	1,186	35	56	1,521

The season opened on 21st May, over two inches of rain falling during the succeeding six days, while the rainfall for the month of June was over an inch above the average. The unusually wet, cold conditions which prevailed proved very

unfavourable for this class of country and all growth was considerably retarded. Comparatively dry conditions were experienced during the first three weeks of August, and towards the end of that month the crops were far from promising, being backward. As the weather became warmer, however, particularly during October, better growth was made by the crops, which improved considerably.

The experiments were conducted on the smokebush and tussocky type of sand-plain.

The land had been ploughed with a disc-cultivating type of plough to a depth of 3 to 4 inches during the previous winter months. During September and October it was again disced 2 inches deep with the same implement and cultivated with tandem disc harrows during late March and early April. Immediately prior to planting ordinary heavy harrows were used.

The experimental plots were each one-eighth of an acre in area, replicated five times and each treatment compared with an adjacent control.

The results of the field experiments conducted during 1933 are tabulated below—

RATE OF SEEDING EXPERIMENT WITH WHEAT.

To determine the most economical rate of planting a midseason free stooling variety.

Planted on 12th May, 1933.

Variety—Nabawa.

Superphosphate—120 lbs. per acre.

Rate of Seed per acre.	Computed Yields per acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933.	Average Yields per acre, 1925-33.	Per-centage Yields, 1925-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60 lbs.	bus. lb. 17 36	bus. lb. 17 4	bus. lb. 17 52	bus. lb. 18 32	bus. lb. 20 32	bus. lb. 18 10	103	bus. lb. 16 27	103
45 lbs.	16 48	17 12	18 8	18 0	18 40	17 46	100	15 58	100
30 lbs.	17 44	18 40	18 16	19 44	20 8	18 54	106	16 26	104

To determine the most economical rate of planting an early, sparse-stooling variety.

Planted on 16th May, 1933.

Superphosphate—120 lbs. per acre.

Variety—"S.H.J."

Rate of Seed per acre.	Computed Yields per acre					Average Yield, per acre, 1933.	Per-centage Yields, 1933.	Average Yields per acre, 1925-33.	Per-centage Yields 1925-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
60 lbs.	bus. lb. 13 12	bus. lb. 14 56	bus. lb. 14 16	bus. lb. 14 16	bus. lb. 13 28	bus. lb. 14 2	102	bus. lb. 13 31	102
45 lbs.	13 20	13 44	14 40	14 24	12 32	13 44	100	13 18	100
30 lbs.	14 8	14 0	14 40	15 20	13 52	14 24	105	13 54	104

Although this year's results show slightly heavier yields from the heavier rates of seeding, the average results, obtained over a period of nine years, indicate that no appreciable advantage is gained by increasing the rate of seeding above 45 lbs. per acre.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month for planting a midseason-maturing variety.

Variety—Nabawa.

Seed—45 lbs. per acre.

Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yields per acre.					Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1928-33.	Percentage Yields, 1928-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
April 15th	bus. lb. 12 8	bus. lb. 14 32	bus. lb. 14 16	bus. lb. 9 36	bus. lb. 11 4	bus. lb. 12 19	85	bus. lb. 16 8	107
May 15th	14 48	16 56	15 36	10 56	13 52	14 26	100	15 2	100
June 15th	16 48	18 48	17 36	15 52	16 56	17 12	119	10 8	67

To determine the most suitable month for planting an early-maturing variety.

Variety—Gluyas Early.

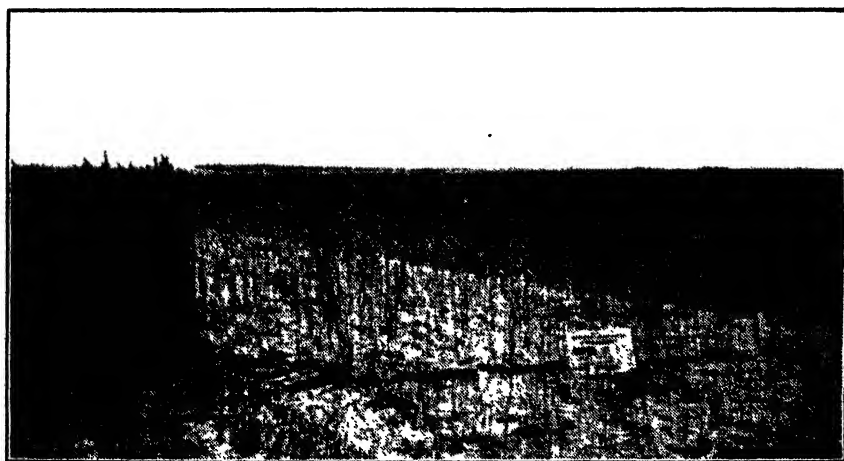
Seed—45 lbs. per acre.

Superphosphate—120 lbs. per acre.

Time of Planting.	Computed Yields per acre					Average Yield, per acre, 1933.	Percentage Yields, 1933.	Average Yield, per acre, 1928-33.	Percentage Yields, 1928-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
June 15th	14 48	10 16	15 20	12 24	11 12	12 48	147	10 32	74
May 15th	10 32	6 56	9 28	8 32	8 8	8 43	100	14 10	100
July 15th	11 12	10 0	12 56	8 40	6 40	9 54	113	6 21	45

The results this year indicate a decided advantage in favour of the later seed-ing. However, the average results, obtained over a period of six years, show definitely that, in normal seasons, it is advisable to plant early and to have all the seed-ing completed by the end of May.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.



Rate of Application of Superphosphate Experiment, Wongan Hills Light Lands Farm, 1933.

The centre plot received no superphosphate. The one to the left received a dressing at the rate of 75 lbs. to the acre and that on the right a dressing at the rate of 150 lbs. per acre.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

(No. 1.)

To determine the most profitable amount of superphosphate to apply to the wheat crop.

Planted on 5th May, 1933.

Variety—Nabawa.

Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per acre.					Average Yields, per acre, 1933	Per-centage Yields, 1933.	Average Yields per acre, 1929-33.	Per-centage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
225 lbs. ...	16 40	16 48	17 36	18 32	17 4	17 20	104	17 9	105
150 lbs. ...	16 24	15 36	17 4	17 28	16 56	16 42	100	16 18	100
100 lbs. ...	17 36	17 36	18 40	19 28	18 40	18 24	110	17 23	107

(No. 2.)

Planted on 5th May, 1933.

Variety—Nabawa.

Seed—45 lbs. per acre.

Rate of Application of Superphosphate.	Computed Yields per acre.					Average Yields, per acre, 1933.	Per-centage Yields, 1933.	Average Yields per acre, 1929-33.	Per-centage Yields, 1929-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
75 lbs. ...	12 24	12 40	12 8	11 28	10 40	11 52	71	12 19	78
150 lbs. ...	17 36	18 0	17 44	17 28	13 20	16 50	100	15 50	100
Nil ...	0 0	0 0	0 0	0 0	0 0	0 0	0	2 32	16

This year's results confirm those of previous years, viz., that it is advantageous to apply considerably more than 75 lbs. of superphosphate on this class of land. Even at present low prices for wheat an application of at least 120 lbs. per acre is warranted.

SEASONAL PLANTING VARIETY TRIAL.

(a) *To ascertain the most suitable month to plant the late, midseason, and early maturing varieties of wheat.*(b) *To determine the most prolific of these types.*

APRIL PLANTING

Planted on 15th April, 1933.

Superphosphate—120 lbs. per acre.

Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per acre.					Average Yields per acre, 1933.	Per-centage Yields, 1933.	Per-centage Yields, 1928-33
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.		
Yandilla King ...	Late ...	12 48	15 20	15 36	14 8	14 0	14 22	91	103
Nabawa ...	Midseason ...	16 24	17 4	18 0	14 32	13 20	15 52	100	100
Sutton ...	Late ...	16 0	16 24	17 28	15 44	15 56		100	*111
Bencubbin ...	Midseason ...	17 36	18 0	18 24	16 48	16 56	17 33	112	†120
Nabawa ...	Midseason ...	17 44	15 44	14 48	15 20	14 40	15 39	100	100
Ghuyas Early ...	Early ...	14 40	15 20	13 28	13 52	12 48	14 2	85	98
Nabawa ...	Midseason ...	18 0	17 36	16 40	14 56	15 12	16 29	100	100
Totadgin ...	Early ...	13 44	14 24	13 44	14 8	13 52	13 58	85	†89

* 1931-33.

† 1930-33.

‡ 1932-33.

This year's results confirm those of the previous year, indicating that an increased yield can be expected when a heavy dressing of a nitrogenous fertiliser is applied. During 1933 a further increase was obtained when a potassic fertiliser was also used. The gain in yield, however, does not warrant the additional cost of these special fertilisers.

RATE OF SEEDING EXPERIMENT WITH OATS.

To determine the most economical rate of planting a late, free-stooling variety.

Planted on 12th May, 1933.

Variety—Algerian.

Superphosphate—120 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.					Average Yields per acre, 1933	Percentage Yields, 1933.	Average Yields per acre, 1926-33.	Percentage Yields, 1926-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
45 lbs.	20 24	24 16	23 16	23 16	26 8	23 24	100	15 21	107
90 lbs.	23 24	22 16	23 32	22 32	25 8	23 22	100	14 22	100
60 lbs.	23 24	24 32	25 8	24 16	26 16	24 35	106	15 39	110

To determine the most economical rate of planting an early, sparse-stooling variety.

Planted on 13th May, 1933.

Variety—Burt's Early.

Superphosphate—120 lbs. per acre.

Rate of Seed per Acre.	Computed Yields per Acre.				Average Yields per acre, 1933.	Percentage Yields, 1933.	Average Yields per acre, 1926-33.	Percentage Yields, 1926-33.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
45 lbs.	16 0	15 8	15 16	17 32	16 4	98	15 30	102
30 lbs.	15 32	15 24	16 8	17 32	16 14	100	15 19	100
60 lbs.	14 0	15 8	14 32	16 32	15 8	93	15 39	103

Section 4 discarded owing to mistake in seeding.

The average results obtained with both varieties over a number of years indicate that no appreciable advantage is gained by sowing over 45 lbs. of seed per acre.

SALMON GUMS EXPERIMENT FARM.

L. G. Seinor, Farm Manager.

The monthly rainfalls as recorded at the farm during 1933, together with the average for the past eight years, are set out hereunder:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.						Nov.	Dec.	Total for year.
					May	June.	July.	Aug.	Sept.	Oct.	Total.		
1933	160	..	177	13	129	137	114	91	69	134	676	160	1,213
Average years	8	47	45	100	83	140	137	141	193	79	823	62	1,276

With the exception of certain experiments on "kopi," the experiments were planted on the sandy surfaced soil typical of the more satisfactory wheat soils of the district.

The land was ploughed with a mouldboard plough during June and early July. It was then cross-cultivated with a rigid-tine cultivator in the spring and again immediately before planting.

The season opened with a fall of 37 points on the 12th May, followed by 81 points during the fourth week of the month and 83 points on the 6th June. During July, August and September cold and, in this district, rather dry conditions, were unfavourable for rapid crop growth. Comparatively good growth was made during the spring months, however, and a satisfactory maturing period was experienced.

The results of the field experiments conducted during 1933 are tabulated below—

DEPTH OF PLOUGHING EXPERIMENT.

To determine the most economical depth to plough when fallowing for the wheat crop.

Planted on 26th May, 1933.

Superphosphate—112 lbs. per acre.

Variety—"Gluyas Early."

Seed—45 lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1933	Percent-age Yields, 1933.	Average Yields per acre, 1929-33.	Percent-age Yields, 1929-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
2 inches	13 28	14 40	14 32	15 4	15 28	14 38	94	13 51	91
4 inches	14 40	16 0	14 40	16 48	15 44	15 34	100	15 10	100
6 inches	15 20	16 48	16 24	17 20	16 32	16 20	106	15 22	101

The average results over five years indicate that there is no necessity to plough deeper than four inches.

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant a midseason maturing variety.

Superphosphate—112 lbs. per acre.

Variety—"Nabawa"

Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre					Average Yields per acre, 1933	Percent-age Yields, 1933	Average Yields per acre, 1928-33.	Percent-age Yields, 1928-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
April 17th ..	11 20	11 36	12 24	12 0	12 48	12 2	111	14 38	106
May 10th ..	10 24	10 32	11 36	10 32	11 12	10 51	100	13 48	100
June 10th ...	8 8	9 4	8 40	7 28	8 8	8 18	76	9 21	68

TIME OF PLANTING EXPERIMENT.

To determine the most suitable month to plant an early maturing variety.

Superphosphate—112 lbs. per acre.

Variety—"Gluyas Early."

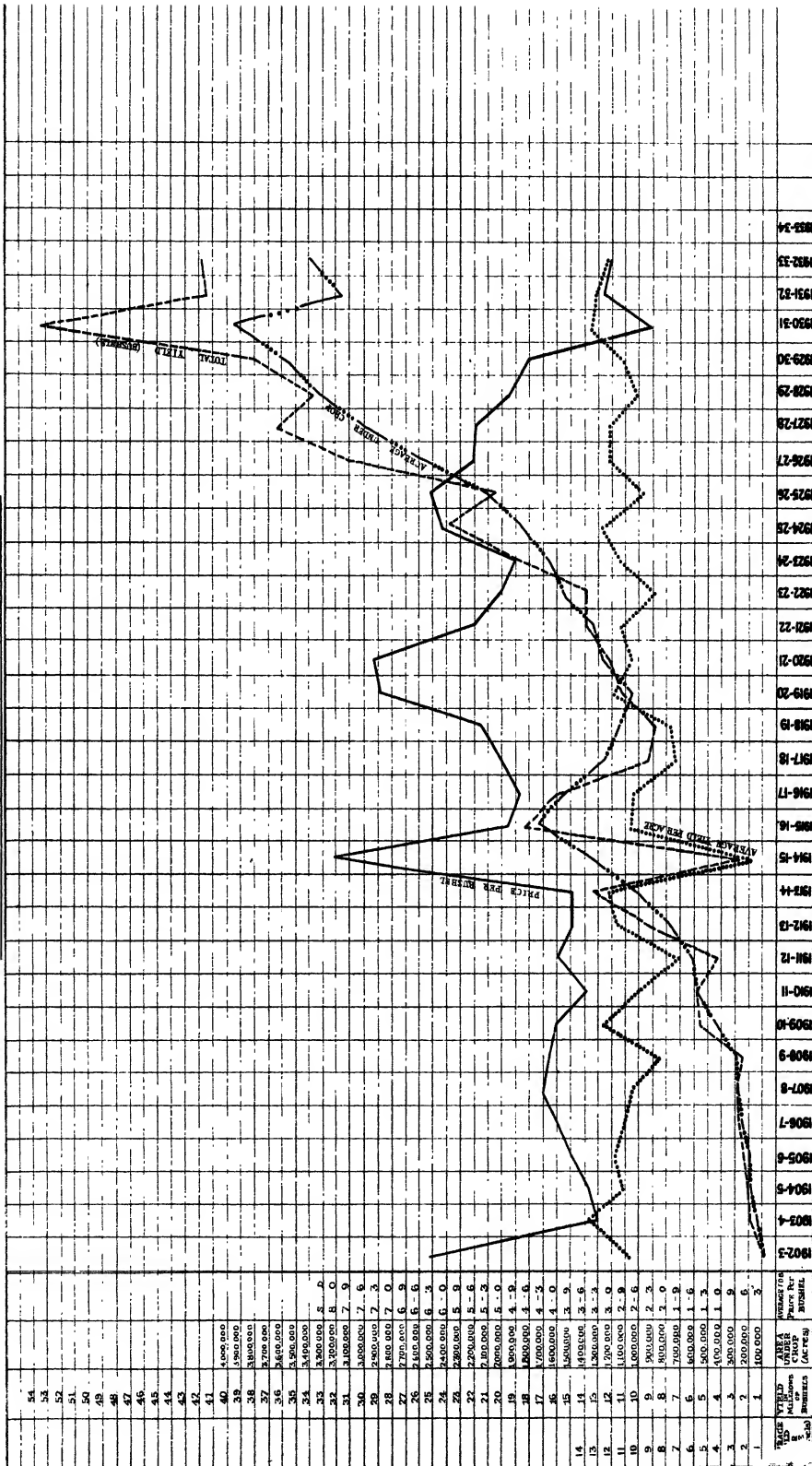
Seed—45 lbs. per acre.

Time of Planting.	Computed Yields per Acre.					Average Yields per acre, 1933.	Percent-age Yields, 1933.	Average Yields per acre, 1928-33.	Percent-age Yields, 1928-33.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
June 18th ...	7 20	9 12	9 12	6 48	7 4	7 55	53	12 21	77
May 18th ...	13 28	16 48	15 20	14 56	14 0	14 54	100	16 4	100
July 22nd ...	6 56	6 16	5 36	5 4	4 48	5 44	38	9 54	62

[illegible]

WHEAT FOR GRAIN

AVERAGE YIELD PER ACRE (Bushels) TOTAL YIELD (Millions of Bushels) AREA UNDER CROP (Acres) AVERAGE PRICE Per Bushel (¢.01)



WESTERN AUSTRALIA, 1902-1933.

The results again show that applications of sulphate of ammonia or sulphate of ammonia and muriate of potash fail to increase wheat yield on this class of soil.

EXPERIMENTS ON "KOPI" SOIL.

Owing to the unsatisfactory crops of wheat generally obtained from the so-called "kopi" soils in the Salmon Gums area, it was decided to conduct experiments with a view to obtaining definite information regarding crop response on this class of soil.

The Salmon Gums "kopi" is described as a light grey highly calcareous soil. It is fairly powdery and represents grey morrel soil of the Eastern wheat belt. With working, it tends to become a little more compact.

The original vegetation included giant mallee, a variety of *Eucalyptus obosa*, and a member of the red morrel family.

The following experiments were conducted; —

1. Fodder trial.
2. Manurial trial.
3. Seasonal planting experiment with oats.
4. Seasonal planting experiment with wheat.

SALMON GUMS "KOPI" EXPERIMENTS.

FODDER EXPERIMENT.

To ascertain the most suitable fodder plant for this type of soil.

Planted on 18th April, 1933.

Superphosphate — 112 lbs. per acre

Fodder.	Rate of Seed per Acre	Calculated Yields per Acre of Green Fodder.			Average Yields per Acre, 1933	Percentage Yields, 1933.	Average Yields per Acre, 1931-33	Percentage Yields, 1931-33.
		Sec. 1	Sec. 2.	Sec. 3.				
Noongaar Wheat	45	lbs. 54	tons. 65	tons. 1.08	tons. 76	43	tons 1 70	53
Mulga Oats	40	1 30	1 84	2 16	1 76	100	3 23	100
Mulga Oats with 1 cwt. Sulphate of Ammonia	40	1 51	2 59	3 13	2 41	137	*	*
Rye	40	2 50	3 02	4 10	3 24	184	3 92	121
Wimmera Rye Grass	4	1 19	1 51	1 84	1 51	86	4 56	141
Wimmera Rye Grass with 1 cwt. Sulphate of Ammonia	4	1 40	2 05	2 70	2 05	116	*	*

* 1933 results only.

This year rye has shown to advantage as a source of green fodder, and Wimmera rye grass has dropped back considerably. The application of 1 cwt. of sulphate of ammonia stimulated the yields of both "Mulga" oats and Wimmera rye grass.

MANURIAL EXPERIMENT—"KOPI" SOIL.

To determine the effects of different fertilisers on the wheat crop on "Kopi" soil.

Planted 1st May, 1933.

Variety—"Gluyas Early."

Superphosphate—112 lbs. per acre.

Seed—45 lbs. per acre.

Treatment per Acre.	Computed Yields per Acre.			Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1932-33.	Percentage Yields, 1932-33.
	Section 1.	Section 2.	Section 3.				
112 lbs Superphosphate ...	bus. lbs. 8 16	bus. lbs. 10 8	bus. lbs. 10 24	bus. lbs. 9 36	137	bus. lbs. 14 26	139
15 tons Stable Manure ...	8 16	10 8	10 24	9 36	137	14 26	139
2 lbs. Superphosphate ...	5 20	7 12	8 32	7 1	100	10 23	100
12 lbs. Superphosphate ..	6 8	7 44	8 48	7 33	108	9 54	95
1 lb. Manganese Sulphate	6 8	7 44	8 48	7 33	108	9 54	95

The results confirmed those of last year, i.e., that heavy dressings of stable manure in addition to superphosphate will definitely increase grain yields.

SEASONAL VARIETY TRIAL—OATS.

"KOPI" SOIL—APRIL PLANTING.

- (a) To ascertain the most suitable month to plant late, mid-season and early varieties of oats.
(b) To determine the most prolific of these varieties.

Planted on 18th April, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mulga ...	Early ...	10 0	10 32	9 24	8 16	9 24	9 27	113	13 33	95
Algerian	Late	8 16	8 32	9 8	8 0	8 16	8 22	100	14 19	100
Guyra ..	Mid-season	8 0	8 16	7 24	7 24	9 8	8 6	95	15 10	105

SEASONAL VARIETY TRIAL—OATS.

"KOPI" SOIL—MAY PLANTING.

Planted on 20th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—40 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Mulga ...	Early ...	6 16	6 32	5 24	6 16	6 16	6 13	99	15 24	123
Algerian	Late ...	5 24	4 0	6 16	7 24	8 16	6 16	100	12 26	100
Guyra ...	Mid-season	5 24	4 0	7 24	8 32	9 8	7 2	110	13 34	110

Although this year "Mulga" was the best yielder in the April planting section, the average results indicate that "Guyra" is likely to give the best results for early planting. In the May planting section "Mulga" did not show to such advantage as in previous years, but the average results show that it is the best variety for later planting.

SEASONAL VARIETY TRIAL—WHEAT.

"KOPI" SOIL—APRIL PLANTING.

- (a) To ascertain the most suitable month to plant the mid-season, early and very early varieties of wheat.
(b) To determine the most prolific of these varieties.

Planted 18th April, 1933.

Superphosphate—112 lbs. per acre.

Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Guyra	Early ...	8 48	6 40	6 56	8 48	5 36	7 22	115	9 36	108
Nabawa.	Mid-season	8 32	5 52	5 52	7 12	4 32	6 24	100	8 51	100
Noongar	Very Early	3 28	3 28	3 12	2 8	1 52	2 50	44	7 10	81

SEASONAL VARIETY TRIAL—WHEAT.

"KOPI" SOIL—MAY PLANTING.

Planted on 17th May, 1933.

Superphosphate—112 lbs. per acre.

Seed—45 lbs. per acre.

Variety.	Maturity.	Computed Yields per Acre.					Average Yields per Acre, 1933.	Percentage Yields, 1933.	Average Yields per Acre, 1931-33.	Percentage Yields, 1931-33.
		Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
		bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.		bus. lb.	
Gluyas	Early ...	7 44	5 20	6 24	5 36	6 24	6 18	133	7 10	115
Early Nabuwa	Mid-season	6 40	4 16	4 16	3 44	4 48	4 45	100	6 14	100
Noonzaar	Very Early	4 32	3 12	2 56	2 40	3 44	3 25	72	5 19	85

For planting in either April or May on this class of soil, "Gluyas Early" has again demonstrated its superiority over the Standard mid-season and very early varieties.

FURTHER FIELD EXPERIMENTS WITH MANGANESE AS A CONTROL OF GREY SPECK DISEASE IN WESTERN AUSTRALIA.

By A. S. WILD,
Agricultural Adviser.

The value of manganese as a fertiliser has been studied in various centres in the West Australian wheat belt and also in the clover belt of the South-West portion of the State (Teakle, Thomas & Hoare, 1933).

The results of these earlier experiments indicate that no significant increase in the yield of either cereals or pastures could be expected from applications of 56 lbs. of manganese sulphate per acre except, perhaps, in the case of the lateritic sandplain soil similar to that at Wongan Hills. The slight acidity of this soil is correlated with an extremely low content of total hydrochloric acid soluble and replaceable manganese. The unavailability of manganese in this instance was correlated with an actual deficiency of manganese in the soil.

A neutral or alkaline soil reaction would contribute to the unavailability of soil manganese. Experiments on the highly calcareous soils of the wheat belt, however, failed to produce a significant increase following the application of manganese sulphate at the rate of 56 lbs. per acre.

Grey speck disease has been described and the occurrence in Western Australia noted by Carne (1927). This disease occurs, in this State, in small patches in which both wheat and oats are affected. It is apparently confined to a limited range of country in the vicinity of the Great Southern railway. Principally it occurs on high-level, powdery soils, usually containing ironstone gravel.

Investigations in South Australia and in North-West Europe have shown that the disease is almost certainly due to a deficiency of available manganese.

Continual recurrence of the disease on the property of Mr. Alan Murray, of Tinkurruin, had led to the recommendation that manganese sulphate be applied to the small affected areas. A rough field experiment conducted in 1932, when approximately 1 cwt. of manganese sulphate per acre was applied to a small area, led to an apparent increase in yield both with wheat and oats. A calculation assessed the increase in the wheat yield as approximately 6 bushels per acre, or 50 per cent.

It was, therefore, decided to conduct a field trial in order to obtain further information and results which would correlate with those obtained in various parts of the wheat belt in 1931, as recorded in the September, 1933, issue of the "Journal of Agriculture."

This experiment was located about two miles south of Tinkurrin siding. The land under test was a high-level, gravelly, powdery soil which originally carried manna gum, morrel and odd salmon gum timber. It had been cleared for many years and, when cropped, showed definite signs of grey speck disease.

During July, 1932, it was ploughed to a depth of $3\frac{1}{2}$ to 4 inches with a mould-board plough. This was followed by a spring-tyne cultivation in September and again in March after rain. The plots were planted on May 16, with a combined cultivator-drill with light drag harrows attached. The variety "Bencubbin" was planted at the rate of 45 lbs. per acre, and superphosphate was applied to all plots, each quarter of an acre in area, at the rate of 112 lbs. per acre. The control plots received no manganese dressing, but to the adjoining plots manganese sulphate at the rates of 56 lbs. and 14 lbs. per acre respectively was applied.

The following are the rainfalls as recorded at the nearest official recording station (Tovil) during the year, together with the average monthly rainfall recordings over a period of 23 years:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sep.	Oct.	Total.			
1933	130	47	132	36	240	302	159	121	113	138	1,073	5	Nil	1,423
Average, 23 yrs.	45	59	82	105	201	237	254	198	155	112	1,157	53	52	1,563

By early July, the control plots (not treated with manganese sulphate) were showing definite signs of grey speck disease. By the middle of August the disease had appeared in both the plots treated with 14 lbs. of manganese sulphate per acre and had become considerably worse in one of the untreated plots. As the season advanced the wheat on the manganese plots recovered from the grey speck disease, but that on the badly affected areas on the untreated plots failed to mature.

The following are the results obtained from the experiment:—

Variety—Bencubbin.

Rate of seed—45 lbs. per acre.

Planted 16th May, 1933.

Rate of 22% super—112 lbs. per acre.

Rate of Manganese Sulphate per Acre.	Computed Yield per Acre.		Average Yield per Acre.	Percentage Yield.
	Section 1.	Section 2.		
56 lbs.	bus. lbs. 16 28	bus. lbs. 14 28	bus. lbs. 15 28	114
Nil	16 44	10 24	13 34	100
14 lbs.	19 24	24 12	21 48	161

Observations made during the course of the experiment, and the results obtained from Section 2 where grey speck disease was most in evidence, indicate that the disease may be controlled by the application of manganese sulphate at the rate of somewhat more than 14 lbs. per acre applied at seeding.

The disease manifests itself in patches of such variable occurrence that the plot yields do not reflect accurately the effect of the manganese sulphate on the diseased patches which failed to mature where not treated with the fertiliser. There is no doubt that, where these patches due to grey speck disease occupy a considerable area in a paddock, manganese sulphate, in addition to superphosphate, can profitably be used as a fertiliser. A dressing at the rate of from 14 to 28 lbs. per acre should be adequate.

In order to ascertain whether the appearance of the disease could be correlated with certain soil properties, an analysis was made in the Government Chemical Laboratory with the results recorded in Table 2.

Both samples are identical with respect to manganese soluble in hydrochloric acid. The amount compares favourably with other soils in Western Australia where no response is shown. The reaction (ph) is slightly acid and on neither of these scores would a deficiency of available manganese be expected. In common with observations in the Eastern States, the disease has shown up on soils of a powdery structure, and the factors connecting manganese availability and this structure have not been determined.

Summary.—Experiments are described showing the effect of managanese sulphate in curing grey speck disease of wheat on powdery soils at Tinkurrin.

The disease occurs on slightly acid, non-calcareous soils containing a considerable proportion of ferruginous (lateritic) gravel.

TABLE 2.

RESULTS OF ANALYSIS OF SOILS FROM A PATCH AFFECTED WITH GREY SPECK DISEASE AND FROM NORMAL CROP ADJACENT.

Samples from Plots not treated with Manganese Sulphate.

Crop.	Sample 1. Affected with Grey Speck Disease.	Sample 2. Normal Crop 5 yards from Sample 1.
Depth (inches)	0—9	0—9
Stones (above 2mm.)	49	42
Manganese soluble in hydrochloric acid as per cent. fine earth (moisture free)—	per cent.	per cent.
as manganese (Mn)	0.0078	0.0078
as manganese oxide (Mn ₂ O ₃)	0.0306	0.0306
Mechanical analysis—		
Coarse sand	42.1	36.8
Fine sand	40.5	33.8
Silt	5.1	5.5
Clay	8.0	15.6
Loss on acid treatment	4.8	0.2
Moisture	1.1	1.9
Loss on ignition	5.3	9.3
ph. (quinhydrone 1 soil to 2.5 water) ...	6.48	6.36

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FALLOW COMPETITIONS, 1934.

A. S. WILD, B.Sc. Agr., Agricultural Adviser.

During the early portion of this year nine district agricultural societies conducted fallow competitions. In each case the inspection of the competing fallows and the allocation of awards was made by officers of the Department of Agriculture.

The scale of points under which the awards were made was as follows:—

Moisture	40 points
Condition of Mulch	10 "
Freedom from Weeds	10 "
Consolidation of Seed bed	20 "
Uniformity of Preparation	20 "
Total	100 points

Except where otherwise specified the competition plots were 50 acres in area.

KARLGARIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

In the competition conducted by the above society six entries were submitted for inspection. Judging took place during January, the awards being made as follow:—

Competitor.	District.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds, 10 pts.	Consol- dation of Seed Bed 20 pts.	Uniformity of Prepar- ation, 20 pts.	Total. 100 pts.
Mouritz, W. ...	Hyden ...	36	9	8	19	17	89
Marshall, H. J. ...	Hyden ...	35	9	8	19	17	88
Green & Atkinson ...	North Hyden ...	37	9	7	16	18	87
James, S. W. ...	Karlgarin ...	35	9	9	16	17	86
Medcalf, C. W. ...	Karlgarin ...	33	8	8	18	18	85
Richter, C. L. ...	Karlgarin ..	34	8	8	17	18	85

The winning entry was that of Mr. W. Mouritz. The land, which originally carried salmon, gimlet and morrel timber, had been tilled with a rigid-tyne scarifier to a depth of 3½ inches during the previous July. This cultivation was repeated early in the following month, and again to a depth of 2½ inches during late August.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing rains.				Spring rains.			Summer rains				Total June to January.
	June	July	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Karlgarin East	186	121	177	484	60	86	146	17	33	5	55	685
Hyden South	145	135	160	440	59	130	189	42	11	17	70	609
Hyden North (Camel Peak)	158	153	168	479	64	168	232	*	*	14	...	*

* Not available

The cultural details of the competing fallows are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Timber.	Cleared.	Ploughed.	Implement	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Mouritz, W. ...	Salmon, gimlet, morrel	..	July ...	Ridg-tine scarifier	inches 3½	Good ..	Ridg-tine scarified 3½ins. deep in early August and again 2½ins. deep late in August
Marshall, H. J. ...	Salmon, gimlet, morrel	1932 ..	July ..	Disc ..	4	Excellent	Spring-tine cultivated in September.
Green & Atkinson ...	Salmon, gimlet, mallee	3 years	June ...	Spring-tine cultivator	2½	Good ..	Spring-tine cultivated in mid-October.
James, S. W. ...	York gum, salmon, gimlet, mallee, little morrel	1925 ...	March and April	Disc ..	2—2½	Hard .	Discd 2½ins. deep in August and again 2ins. deep in late September.
Medcalf, C. W. ...	Salmon, mallee, gimlet morrel	1924 ..	August	Disc ..	3	Indifferent	Discd 2ins. deep in September. Spring-tine cultivated in October.
Richter, C. L. ...	Salmon and mallee ...	6 years ...	late June	Disc ..	4	Good	Spring-tine cultivated in early September

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

Seven fallows were judged during January for the fallow competition conducted by the Phillips River Agricultural Society. Points were allocated and awards made as follow:—

Competitor.	District.	Moisture.	Mulch.	Freedom from Weeds.	Consoli- dation of Seed bed.	Uniform- ity of Pre- paration.	Total.
		40 pts.	10 pts.	10 pts.	20 pts.	20 pts.	100 pts.
Campbell, J. ...	Mt. Short ...	38	9	8	19	18	92
Bebbington Bros. ...	Mt. Short ...	39	8	8	18	18	91
Dilley, A. F. ...	Mt. Short ...	37	9	8	17	17	88
Barrett Bros. ...	Ravensthorpe ...	35	9	7	18	17	86
Chambers Bros. ...	Ravensthorpe ...	34	8	9	16	19	86
Love, J. W. ...	Ravensthorpe ...	35	7	7	19	17	85
Shinner, E. ...	Ravensthorpe ...	35	8	9	16	17	85

Mr. J. Campbell's entry secured first place. This was on jam, salmon and mallee country which had been ploughed with a mouldboard plough during early June to a depth of 3½ inches. During November it was cultivated after rains had fallen.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing rains.				Spring rains.			Summer rains.				Total June to January.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Ravensthorpe	156	68	189	413	104	164	268	132	109	38	279	960
Mt. Short	134	72	158	364	75	141	216	161	86	16	263	843

The cultural details of the competing fallows are summarised in the following table:—

CULTURAL DETAILS

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Campbell, J.	...	Old land...	Early June	Mouldboard	Inches. 3½	Good	Spring-tine cultivated in late November after rain.
Bebbington Bros.	Mallee and sprinkling of salmon	2 years	Early June	Mouldboard and disc	3—4	Good	Spring-tine cultivated in mid-June to full depth of ploughing.
Dilley, A. F.	Salmon and little mallee	3 years	July	Disc	3	Fair	Disc and 2lbs. deep in September.
Barrett Bros.	Salmon and gimlet	1933	July	Disc	2½—3	Good	Spring-tine cultivated in early October.
Chambers Bros.	Gimlet and salmon	Old land	July	Mouldboard	3½—4	Good	Spring-tine cultivated in September.
Love, J. W.	Salmon and mallee	1928	July	Mouldboard	3½	Fair	Nil.
Shinner, E.	Gimlet and mallee	6 years	Late July	Mouldboard	4	Fair	Spring-tine cultivated late September.

NUNGARIN AGRICULTURAL SOCIETY.

Judge: K. T. Lutz, Agricultural Adviser.

The inspection of the thirteen entries in the fallow competition conducted by the Nungarin Agricultural Society took place during late February. The judge's awards are as follow:—

Competitor.	District.	Molsture.	Mulch.	Freedom from Weeds.	Consoli- dation of Seed bed.	Uniform- ity of Pre- paration.	Total.
		40 pts.	10 pts.	10 pts.	20 pts.	20 pts.	100 pts.
Dunkley, G. A. ...	Ye'beni ...	32	9	9	19	17	86
Creagh Bros., Ltd. ...	Kwelkan ...	34	8	8	17	17	84
Evan's, L. D. ...	Nukarni ...	32	8	8	18	17	83
Green, T. W. ...	Kwelkan ...	34	8	7	17	17	83
Johnson, J. H. ...	Mangowine ...	32	8	9	17	17	83
Williams, F. A. ...	Mangowine ...	31	8	9	18	16	82
Jolly, R. P. ...	Mangowine ...	30	8	9	17	17	81
Brown, H. T. ...	Nukarni ...	28	7	9	18	18	80
Crooks, E. ...	Nukarni ...	31	8	7	18	16	80
Maughan, J. S. ...	Nukarni ...	28	8	7	19	18	80
Vernon, G. J. ...	Nukarni ...	31	8	7	18	16	80
Browne, C. T. ...	Nukarni ...	31	7	7	18	16	79
Farrell, G. C. ...	Nungarin ...	31	7	6	16	17	77

The fallow submitted by Mr. G. A. Dunkley secured first place. This land originally carried gimlet, mallee, tea-tree, and odd salmon gum timber. It had been worked during June with a rigid-tyne scarifier to a depth of three inches and disc cultivated the following month. The rigid-tyne scarifier was again employed to cultivate the land in August and also after rain in December.

The following are the monthly rainfalls as recorded from June to February at the various centres concerned in the competition:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to Feb- ruary.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Ye'beni ...	288	159	236	683	80	93	173	88	39	53	51	231	1,087
Mangowine	230	141	161	532	94	69	163	67	40	36	52	204	890
Nukarni ...	196	154	195	545	65	99	164	31	45	104	14	194	903
Nungarin ...	275	185	157	597	56	64	120	77	49	99	24	249	966

The cultural details of the fallows entered in the competition are given below:—

Competition.	Original Timber	When Ploughed	Implement	Depth	Condition of Land.	Subsequent Cultivations.	Sheep.
Dunkley, G. A. ...	Gimlet, mallee, tea-tree and salmon gum	June	Right-tyne or other	inches 3	Silt	Disc cultivated in July; scarified in August and after rain in December	Yes
Creagh Bros., Ltd. ...	Mallee jam, salmon gum and gimlet	End of June	Disc cultivating plough	3½	Wet	Scarified end of August; spring-tyne cultivated end of September	Yes
Evans, L. D. ...	Gimlet and salmon gum	End of June ..	Mouldboard	3	Good	Harrowed in July; disc cultivated in August and then harrowed	Yes
Green, T. W. ...	Salmon gum gimlet, mallee and jam	End of June	Disc plough	3	Good	Spring-tyne cultivated in August and September	Yes
Johnson, J. H. ...	Gimlet salmon gum and tea-tree	End of June	Disc cultivating plough	4	Good	Disc cultivated in August; spring-tyne cultivated in September	Yes
Williams, F. A. ...	Salmon gum and gimlet	End of June	Mouldboard	3-4	Good	Scarified in August; spring-tyne cultivated in October	Yes
Jolly, H. P. ...	Salmon gum, mallee and odd morrell	End of July ..	Mouldboard	3	Good	Spring-tyne cultivated in September; harrowed in February	No
Brown, H. T. ...	Gimlet and salmon gum	Beginning of July	Right-tyne scarifier	2½	Good	Scarified in August and November; rolled in January	Yes
Crooks, E. ...	Salmon gum gimlet and mallee	Middle of July	Disc cultivating plough	3½	Good	Spring-tyne cultivated in September	Yes
Maughan J. S. ...	Salmon gum and gimlet	End of July	Disc plough	4	Fair	Spring-tyne cultivated in August, September and October	Yes
Vernon, G. J. .	Salmon gum and gimlet	End of July	Mouldboard	2½-3	Good	Disc cultivated twice in September; harrowed at end of September	Yes
Browne, C. T. ..	Salmon gum, gimlet jam and mallee	End of July	Disc cultivating plough	2½-3	Good	Spring-tyne cultivated at end of August and again at end of September	No
Farrell, G. C.	Salmon gum and gimlet, yorrell and tea-tree	Middle of July	Disc plough and partly with disc cultivating plough	2½	Good	Tandem disc cultivated at the end of August	Yes

MUKINBUDIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The fallow competition conducted by the Mukinbudin Agricultural Society was judged during the last three days of February, nine entries being inspected. Details of the awards made are shown below:—

Competitor.	Centre.	Moisture	Mulch.	Freedom	Prepara-	Evenness	Total.
		40 pts.	10 pts.	from Weeds. 10 pts.	tion of Seed Bed. 20 pts.	of Pre- paration. 20 pts.	
Stickwick, W. N. ...	Karloning ...	34	8	9	10	10	80
Pearce, E. E. ...	Wilgoyne ...	36	8	9	18	17	88
Dixon, W. ...	Lake Brown ...	34	7	8	19	10	87
Shadbolt, H. J. ...	Mukinbudin ...	34	8	8	18	18	86
Payne, B. ...	Lake Brown ...	34	8	7	18	18	85
Williams, F. A. ...	Nungarin ...	31	9	8	18	18	84
Manuel, C. J. ...	Mukinbudin ...	29	9	8	17	10	82
Clamp, A. ...	Mukinbudin ...	32	7	6	18	17	80
Mulqueeny, J. ...	Lake Brown ...	29	8	8	17	18	80

Mr. W. N. Stickwick's entry secured first place. This fallow was on salmon, mallee and gimlet country which had been disc ploughed during July to a depth of 3 to 3½ inches. The spring-tyne cultivator was then used for the three succeeding cultivations in August, September and October respectively. After rain in December the land was harrowed.

This entry was very commendable in all respects except that the mulch was a little too fine. Most of the fallows entered in this competition were at fault in this respect.

The rainfalls as recorded at the centres where the competing fallows were located are shown below:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains					Total June to Feb- ruary.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Karloning	287	90	163	546	48	90	138	81	85	Nil	29	195	870
Wilgoyne	231	87	143	466	59	52	111	128	211	Nil	16	355	932
Mukinbudin	233	112	156	501	69	78	147	84	110	41	30	265	913
Nungarin ...	275	165	157	597	56	64	120	77	40	99	24	249	966
Lake Brown	218	114	151	483	48	43	91	80	30	54	Nil	164	738

The cultural details of the competing fallows are summarised as hereunder:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
Stickwick, W. M. ...	Salmon mallee and gumlet	1930	Late July	Disc	inches. 3-3½	Good	Spring-tyne cultivated in late August, again early in September, and again in October. Harrowed in December after rain.
Pearce, E. E. ...	Mixed gumlet, tea-tree and mallee, jam and scrub	1924	June	Mouldboard	3-4	Good	Rigid-tyne scarified in September and harrowed in November after rain.
Dixon, W. ...	Salmon and gumlet	10 years	Late June	Mouldboard	4	Good	Spring-tyne cultivated in August and again late in September. Harrowed in November after rain.
Shadbolt, H. J. .	Salmon and gumlet	1917	June	Rigid-tyne scarifier	3	Good	Rigid-tyne scarified late July 2½ ins. deep and again 2 ins. deep late August.
Payne, B. ...	Mallee and gumlet	1931	Late June	Disc	3	Good	Rigid-tyne scarified 2½ ins. deep in August and again 2 ins. deep in December after rain.
Williams, F. A. .	Salmon and gumlet	Old land	June	Mouldboard	3-4	Fair	Rigid-tyne scarified in August, and spring-tyne cultivated in October.
Mannell, C. J	Salmon, gumlet morrel	1916-17	Early July	Mouldboard	3½	Fair	Rigid-tyne scarified late in August, and spring-tyne cultivated in November.
Clamp, A. .	Salmon gumlet jam	1925	June	Disc	4	Good	Spring-tyne cultivated in August, and again in September. Harrowed in February.
Mulqueeney, J	Salmon, morrel, gumlet	11 years	March 1933	Disc	4	.	Discd early in August and again in November, after rain. Spring-tyne cultivated in December, after rain.

SOUTHERN CROSS AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

Only three entries were received for the 150-acre fallow competition conducted by this society. These were inspected on the 6th March, awards being made as follow :—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Prepara- tion of Seed Bed. 20 pts.	Evenness of Pre- paration. 20 pts.	Total. 100 pts.,
White, Geo. (senr.) ...	Bullfinch ...	36	8	9	18	18	89
Smith. P. J. ...	Turkey Hill ...	34	7	7	17	17	82
Stacey J. B. ...	Southern Cross ...	35	7	6	16	17	81

The entry of Mr. Geo. White, senr., of Bullfinch, was placed first. This fallow was on salmon and gimlet country which had been disc ploughed in July to a depth of three inches. This was followed by a spring-tyne cultivation in August and a harrowing in September. This last-mentioned cultivation had left the surface of the fallow a little too fine and flat.

The following are the monthly rainfalls as recorded from June to February at the centres where the competing fallows were located :—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains					Total June to Feb- ruary.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Southern Cross Bullfinch	213	111	202	526	37	40	86	52	60	121	..	242	854
	160	153	126	439	75	72	147	50	196	14	...	260	855

Below are summarised the cultural details of the fallows entered in the competition :—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations
White, Geo. (senr.)...	Gimlet and salmon gum	1929-30 ...	July'	Disc	Inches. 3	Good	Spring-tyne cultivated in August, and harrowed in September.
Smith, P. J. ...	Salmon, gimlet, mallee, jam	3 years ...	June-August ...	Disc	3	Good	Spring-tyne cultivated 3ins. deep during August to September; Portion again spring-tyne cultivated.
Stacey, J. B. ...	Morrel and tea-tree ...	1926 ...	July	Disc	4	Good	Spring-tyne cultivated in August.

MERREDIN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The Merredin Agricultural Society this year again conducted a fallow competition. Fifteen competition plots were inspected between the 8th and 13th of March. The awards made are as shown below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Prepara- tion of Seed-bed. 20 pts.	Evenness of Pre- paration. 20 pts.	Total. 100 pts.
Maughan, Mrs. E. M. ...	Nukarni ...	36	9	9	19	19	92
Teasdale, H. W. ...	Belka ...	35	9	9	19	19	91
Reichelt, E. E. ...	North Burracoppin ...	36	9	9	18	18	90
Barnett, L. T. C. ...	North Walgoolan ...	35	9	9	18	18	89
McPharlin & Sons ...	South Burracoppin ...	37	9	7	18	18	89
Cook, W. T. ...	South Burracoppin ...	34	8	8	19	19	88
Kaye, John ...	Baandee ...	35	8	8	18	19	88
Maughan, J. D. ...	South Walgoolan ...	36	8	7	19	18	88
Walston, R. ...	Walgoolan ...	34	9	9	18	18	88
Harling, H. H. ...	Merredin ...	34	8	9	18	18	87
Clothier, J. E. ...	Merredin ...	34	8	8	18	18	86
Emmett, H. C. ...	Goomarin ...	33	8	8	19	18	86
Flockhart, I. H. ...	Korbel ...	33	9	8	18	18	86
Smalcombe, T. H. ...	Merredin ...	32	7	8	17	19	83
Cockram, W. H. ...	Nukarni ...	33	8	6	17	18	82

During the course of judging these fallows, rain, ranging from about 40 points at Walgoolan to about 100 points at Baandee, fell. This entailed some difficulty in adjusting the points awarded for moisture content so that no disadvantage would be placed on the fallows judged before this rain. Consequently the surface moisture was more or less disregarded and the points under this heading allocated on what moisture was apparently in the fallow (below the surface) prior to the March rain.

Mrs. E. M. Maughan's entry secured first place, being closely followed by that of Mr. H. W. Teasdale.

The winning fallow had been scarified three inches deep during April, 1933. It was again rigid-tyne scarified to the same depth during the following June, again two inches deep in August and also in September. During October it was spring-tyne cultivated, this operation being repeated after rain had fallen during March.

Mr. Teasdale's fallow had been disc ploughed to a depth of three inches during the previous June and July and then rigid-tyne scarified during August. It was then spring-tyne cultivated in September and again in March. Both these fallows were particularly good and but very little separated them.

The monthly rainfalls as recorded at the various centres are given below:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to February.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Feb.	Total.	
Merredin ...	248	139	199	586	63	123	186	50	28	78	13	169	941
Nukarni ...	196	154	195	545	65	99	164	31	45	104	14	194	903
Belka ...	228	184	168	525	102	125	227	42	34	61	25	162	914
Burracoppin ...	205	182	187	524	55	63	118	44	45	30	66	185	827
Ulva ...	311	170	167	648	72	144	216	44	130	42	25	241	1,105
Walgoolan ...	262	160	238	660	55	49	104	68	27	<i>Nil</i>	<i>Nil</i>	95	859
Baandee ...	248	82	123	453	59	80	148	23	86	88	14	211	812
Goomarin ...	317	168	231	716	49	49	98	63	52	36	40	191	1,005

* Not available.

Cultural details of the fallows inspected for this competition are set out hereunder:—

CULTURAL DETAILS.

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
Maughan, Mrs. E. M.	Salmon and gimlet ...	Old land ...	April, 1933 ...	Rigid-tyne scarifier	inches, 3	Dry ...	Rigid-tyne scarified 3ins. deep in June, again 2ins. deep in August, and again in September. Spring-tyne cultivated in October, and again in March, after rain.
Teasdale, H. W. ...	Gimlet and salmon ...	Old land ...	June and July	Disc	3	Good ...	Rigid-tyne cultivated in August. Spring-tyne cultivated in September, and again in March, after rain.
Reichett, E. E. ...	Salmon and tea-tree ...	7 years ...	June ..	Rigid-tyne scarifier	3	Fair ...	Rigid-tyne scarified late in July and again in mid-September. Harrowed after each of the three rigid-tyne cultivations.
Barnett, L. T. C. ...	Salmon and gimlet ...	Old land ...	June ..	Disc	3	Good ..	Spring-tyne cultivated 3ins. deep in July. Spring-tyne cultivated in September and again in November. Portion spring-tyne cultivated in December, after rain.
McPharlin & Sons	Gimlet and mallee ...	4 years ...	Mid-June ...	Disc	3	Good ...	Spring-tyne cultivated 2ins. deep in August, and again 2ins. deep in October.
Cook, W. T. ...	Salmon and boree ...	1924 ...	July ...	Disc	3	Good ...	Rigid-tyne scarified 3ins. deep in August, and again 2ins. deep in September.
Kaye, John	Mixed salmon, morrel, gimlet, tea-tree	Old land ...	June and July	Mouldboard	4	Good ..	Rigid-tyne cultivated in September. Spring-tyne cultivated in October. Harrowed in December, after rain.
Maughan, J. D. ...	Gimlet and salmon ...	1924 ...	June ...	Disc	3½	Good ...	Disc 3½ins. deep in July. Rigid-tyne scarified 3½ins. deep in September. Spring-tyne cultivated 2ins. deep late in September.

CULTURAL DETAILS—continued.

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Watson, R. ...	Gimlet and salmon ...	1923 ...	Early July ...	Disc ...	3½	Good ...	Right-tyne cultivated late in September.
Harling, H. H. ...	Chiefly white-gum and scrub	5 years ...	June and July	Disc ...	3½—4	Good ...	Spring-tyne cultivated in August, and again in September.
Clothier, J. E. ...	Malke and scrub ...	Old land ...	Late June ...	Disc ...	3	Good ...	Spring-tyne cultivated in August, and again in September.
Emmett, H. C. ...	Salmon-gum, gimlet and mallee	1917 ...	Third week in June	Mouldboard	3—4	Fairly good ...	Right-tyne scarified in July, and again the last week in August. Spring-tyne cultivated and harrowed last week in January.
Flockhart, I. H. ...	Salmon and gimlet ...	Old land ...	Late June ...	Disc ...	3½	Hard ...	Diced late in July. Spring-tyne cultivated in mid-September, and again early in December, after rain.
Smallscombe, T. H. ...	Chiefly gimlet	Old land ...	Late June ...	Mouldboard	3½—4	Good ...	Diced 3ins. deep late in August. Spring-tyne cultivated in September.
Cockran, W. H. ...	Jun, mallee, gimlet, murrel	Old land ...	March, 1933 ...	Disc ...	Scratched	Hard ...	Diced 3ins. deep late in July, and again 3ins. deep in August. Spring-tyne cultivated in September, and again in October.

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

The eight entries judged for the fallow competition conducted by the Bruce Rock Agricultural Society were inspected between March 14th and 18th.

Earlier March rains had increased the moisture content, commenced the germination of weed seeds and compacted the mulch of many of these fallows, and consequently they were not seen to best advantage.

The awards made are shown below:—

Competitor.	Centre.	Moisture 40 pts.	Mulch. 10 pts.	Freedom from Weeds. 10 pts.	Prepara- tion of Seed Bed. 20 pts.	Evenness of Pre- paration. 20 pts.	Total. 100 pts.
Pimlott, S. H.	Kwolyin	36	9	9	19	19	92
Currie, J. J.	Bruce Rock ...	34	8	8	19	19	88
Cole, R. T.	Bruce Rock ...	34	7	9	19	18	87
Fuachbichler, M. ...	Bruce Rock ...	35	9	7	18	18	87
Stavens, D.	Bruce Rock ...	35	9	8	17	18	87
Schilling, C. E. & N. S. ...	Bruce Rock ...	34	7	9	18	18	86
Smith, C. & A. H. ...	Bruce Rock ...	33	8	9	18	18	86
Buller & Black	Babakin	30	7	7	19	16	85

Mr. S. H. Pimlott's winning fallow was, in every respect, very good. This land, which originally carried ginlet and salmon timber, had been rigid-tyne scarified three inches deep during the previous June. It was then spring-tyne cultivated in July, again in August, and again in March after rain. This working resulted in an even, well-worked fallow, free of weed growth and showing a desirable mulch and well-prepared seed-bed.

The rainfall recorded at the centres concerned with the competition are shown hereunder:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.					Total June to Feb- ruary.
	June.	July.	Aug.	Total	Sept.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Total.	
Bruce Rock	211	124	133	468	87	113	200	29	44	36	NH	109	777
Babakin ...	193	159	168	520	52	134	186	12	31	5	29	77	783
Kwolyin ...	264	117	120	501	76	133	209	23	7	46	18	94	804
Yarding ...	224	144	128	496	48	229	277	18	74	10	17	119	892

The following table shows the summarised cultural details of the fallows judged for the competition:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of ploughing.	Condition of land at ploughing.	Subsequent cultivations.
Pinlott, S. H.	Gimlet and salmon ...	Old land ...	Mid-June ...	Rigid-tyne scarifier.	inches. 3	Good. ...	Spring-tyne cultivated in July, again in August, and again in March, after rain.
Currie, J. J.	Chiefly gimlet ...	Old land ...	Late June ...	Mouldboard	3	A little dry. ...	Spring-tyne cultivated late in August, again in early September, again early in October, and again early in December, after rain.
Cole, R. T. ...	Gimlet and salmon ...	Old land ...	Early July ...	Disc. ...	3½	Good. ...	Rigid-tyne scarified early in August, Spring-tyne cultivated early in September, and again early in October.
Fuschblehler, M. ...	Chiefly gimlet ...	Old land ...	Mid-July	Rigid-tyne scarifier.	3	A little hard. ...	Rigid-tyne scarified 3ins. deep mid-August. Spring-tyne cultivated late in September, and again late in October.
Stevens, D. ...	Morrel and salmon ...	Old land ...	July ...	Disc. ...	3	Good. ...	Spring-tyne cultivated in August, and again in September.
Schilling, C. E. and N. S.	Salmon and gimlet ...	Old land ...	Early June ...	Mouldboard	3	Good. ...	Rigid-tyne scarified end July, cross-spring tyne cultivated September.
Smith, C. & A. H.	Salmon and gimlet ...	Old land ...	Mid June ...	Mouldboard.	2½	Fair. ...	Rigid-tyne scarified twice.
Buller & Black ...	Gimlet, salmon, mallee	Old land ...	Late July ...	Disc. ...	3	Hard. ...	Rigid tyne scarified in August.

KIRWAN AGRICULTURAL SOCIETY.

Judge: A. S. Wild, Agricultural Adviser.

There were nine competitors in the fallow competition conducted by the Kirwan Agricultural Bureau. The competition plots were judged at the end of March.

Details of the awards made are given below:—

Competitor.	Centre.		Molsture	Mulch.	Freedom	Prepara-	Evenness	Total.
			40 pts.	10 pts.	from Weeds. 10 pts.	tion of Seed Bed. 20 pts.	of Pre- paration. 20 pts.	
Mitchell, J. A. & H. A. (Plot 1)	Kokardine	...	36	8	9	18	18	89
Joynes, G. ...	Kokardine	...	36	8	9	17	17	87
Mitchell, J. A. & H. A. (Plot 2)	Kokardine	..	34	8	8	17	17	84
Strahan Bros. ...	Kirwin	...	33	8	7	17	17	82
Booth, W. J. ...	Kokardine	...	33	6	7	16	18	80
Stanwix, E. ...	Kirwan	...	30	9	6	18	17	80
Broadhurst, E. & W. L.	Burakin	...	34	6	6	16	15	77
Leach, J. ...	Kirwan	...	31	6	6	16	16	75
Montague, J. S. ...	Kirwan	...	31	6	6	16	16	75

Most of the fallows inspected were on light country. Being a comparatively new district very few of the settlers possess sheep. The absence of stock was reflected by the fallows. Generally weed growth was very noticeable, and where efforts had been made to control these by cultivation alone the seedbed and general condition of the fallow had suffered as a result of injudicious working.

The rainfall as recorded from June to March, inclusive, is shown below:—

Centre.	Fallowing rains.				Spring rains				Summer rains.					Total June to March.
	June	July	Aug.	Total	Sept.	Oct.	Total	Nov.	Dec.	Jan.	Feb.	Mar.	Total	
Kulja	389	134	246	769	30	70	100	60	20	40	NW	56	185	1,054

The cultural details of the fallows entered in the competition are summarised hereunder:—

Competitor.	Timber.	Cleared.	Ploughed.	Implement.	Depth of Ploughing.	Condition of Land at Ploughing.	Subsequent Cultivations.
Mitchell, J. A. & H. A., Plot 1	Tussocky sandplain ...	5 years ...	Late July ...	Spring-tyne cultivator.	Inches. 2	Good. ...	Spring-tyne cultivated late in August, and again in November. Harrowed late in November, after rain, and again in February.
Joyes, G. ...	Mixed gimlet, jam, mallee, tea-tree	5 years ...	July ...	Disc. ...	3½	Good. ...	Discd 2½ins. to 3ins. in August, again 2½ins. deep in September, and again 2½ins. deep in February, after rain.
Mitchell, J. A. & H. A. Plot 2	Tussocky sandplain ...	4 years ...	August ...	Spring-tyne cultivator.	2	Good. ...	Spring-tyne cultivated twice in September. Harrowed late in November after rain, and again late in February after rain.
Strahan Bros. ...	Tussocky sandplain ...	1928 ...	June and July	Disc. ...	4	Good. ...	Harrowed late in August.
Booth, W. J. ...	Salmon and gimlet ...	Old land ...	Late August ...	Mouldboard. ...	4	Drying out. ...	Nil.
Stanwix, E. ...	Salmon and gimlet ...	7-8 years...	July ...	Disc. ...	3-3½	Good. ...	Spring-tyne cultivated late in July. Discd 2½ins. deep in September, and spring-tyne cultivated late in September.
Broadhurst, E. & W. L.	Tussocky sandplain ...	4 years ...	Late June ...	Disc. ...	3½ 4	Good. ...	Discd 2½ins. deep late in October.
Leach, J. ...	Tussocky sandplain to mallee plain	1927 ...	June ...	Disc. ...	3	Good. ...	Nil.
Montague, J. S. ...	York gum and jam to scrub plain	1925 ...	July ...	Disc. ...	3	Good. ...	Portion discd 2½ins. deep.

CARNAMAH AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Agricultural Adviser.

Only three entries were judged for the fallow competition conducted by the Carnamah Agricultural Society.

The inspection of these fallows took place during January, awards being made as hereunder:—

Competitor.	Address.	Moisture. 40 pts.	Condition of Mulch. 10 pts	Freedom from Weeds. 10 pts.	Consoli- dation of Seedbed. 20 pts.	Uniformity of Prepar- ation. 20 pts.	Total 100 pts.
Forrester, J. K. ...	Carnamah ...	37	8	7	18	16	86
Clark R. W. ...	Carnamah ...	36	7	8	16	16	83
Adams J. L. ...	Winchester .	29	6	6	15	14	70

The rainfall recorded from June to December, inclusive, is shown in the following table:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.			Total June to December.
	June	July	Aug.	Total	Sept.	Oct.	Total	Nov.	Dec.	Total	
Carnamah	628	201	366	1,195	76	98	174	41	34	75	1,444
Winchester	458	161	329	948	75	88	163	44	28	72	1,183

The following table shows the summarised cultural details of the competing fallows:—

Competitor.	Original Timber.	When Cleared.	No. of Crops.	Rotation.	When Ploughed.	Implement.	Condition of Land.	Depth.	Subsequent Cultivations.
Forrester, J. K., Carnamah.	Heavy york gum and black wattle.	1914	10	3 years : fallow, crop, pasture.	July	Heavy disc.	Wet and cloddy	ins. 4	Rigid-tine scarified in August and again end of September after rain.
Clerk, R. W., Carnamah.	Salmon and York gum and little jan.	1913	6 crops in 12 years.	3 years : fallow, crop, pasture.	Mid-June	Heavy disc.	Good.	4	Spring-tine cultivated in August and in September ; portion disc cultivated end October on account of donblegees.
Adams, J. L., Winchester.	Salmon gum	1926	4	2 years : fallow, crop.	End June.	Disc cultivator.	Good.	3-4	Cultivated with combined cultivator-drill early September, and 1st week in October.

This was the first occasion on which a competition of this nature has been conducted in the district. Although the number of competitors was small, a keen interest was taken in the competition.

The winning entry, that of Mr. J. K. Forrester, scored on account of its tilth and depth of mulch, which was reflected in the high moisture content of the subsoil.

The mulch on the second competitor's entry was too fine and level, due to a disc cultivation given at the end of October to kill double-gees.

The seed beds of all the entries were ridged, indicating that the cultivating implements needed adjustment.

It is hoped that next year a larger number of entries will be received, and that competitors or any other interested members of the Agricultural Society will accompany the judge on his tour of inspection.

CONCLUSION.

Generally the standard of the entries in these fallow competitions ranged from good to poor. In the older established districts, adequate plant and power often enables work to be accomplished earlier and better than is possible in newer districts, where farmers have not yet acquired their full equipment. Sheep also play an important part in the production of good fallow. Where sheep were not carried there was usually a noticeable increase in the amount of weed growth. In other cases, attempts to destroy weed growth by cultivation and not by sheep had necessitated working with implements which had interfered with the seedbed and reduced the value of the fallow accordingly. The primary object of fallow competitions is to provide a means of instruction by bringing the farmer into closer touch with the Department of Agriculture.

To produce good fallow a farmer must first realise what is required. His work must be directed towards preparing a suitable compact seedbed and a desirable mulch and the control of weed growth, and all cultivations should be given with these objects in view.

The seedbed should be firm but not hard, and the subsoil should contain the maximum amount of moisture. The seedbed should be comparatively level and uniform, rather than ridged. Such ridging or unevenness may be caused by the use of a disc implement for late cultivation, or by the tynes, pressure springs, etc., of a tyned cultivator being out of adjustment.

Immediately prior to seeding, the mulch should not be deeper than two inches. This necessitates constant attention to the control levers of the implement used for the later cultivations. The mulch should have a reasonably level but somewhat corrugated surface and a fair sprinkling of small clods up to two inches in diameter. Such a mulch assists in preventing the surface soil from setting down hard after subsequent rains followed by dry weather.

M. T. PADBURY TROPHY COMPETITION.

I. THOMAS,

Superintendent of Wheat Farms.

A further year's results are available for the above competition, which has now been conducted for a period of four years, viz., 1930-33 inclusive.

This competition was inaugurated in 1930 as the result of a generous donation made by Mr. M. T. Padbury, a pioneer farmer of the Moora district, and will cover a period of ten years, i.e., the final year will be in 1939.

The trophy is a handsome shield, and each year a replica is made and presented to the winner for that year. This minor trophy was won for the past season by Messrs. F. M. & J. L. Atkins, of Jonerdine, via Lake Brown, who obtained the splendid average of 3 bushels 39 lbs. per inch of rainfall over an area of 376.6 Acres.

These farmers were also successful in 1931 with an average yield of 3 bushels 0 lbs. per inch. Last year's figure of 3 bushels 39 lbs. constitutes an official record for this State, the record being previously held by Mr. F. A. Williams, of Mangowine, via Nungarin, with an average of 3 bushels 23 lbs. per inch of growing period rain.

The conditions under which this competition is conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed from the results of the five seasons in which the competitor produced the highest acre-yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year, and until further notice, it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms, he will be required to supply details regarding the production and marketing of the crops on same, and, though usually the award will

be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain, and determined from the actual amount of wheat sold, as shown by the delivery dockets, plus the amount retained for seed, for home use or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The results for 1933, together with the composite results for the four years the competition has been conducted, are as follow:—

M. T. PADBURY TROPHY COMPETITION.

RESULTS FOR 1933-34.

Competitor.	Address.	Rainfall during Growing Period.	Area Harvested	Yield.			
				Gross.	Average per Acre	Average per 1in. growing period Rain.	
		points.	acres.	bus. lbs.	bus. lbs.	bus.	lbs.
Atkins, F. M. & J. L. ...	Joneville, <i>via</i> Lake Brown	625	376 6	8,580 0	22 47	3	39
Nottage, R. B.	Tammin ...	985	289 7	9,658 16	33 20	3	23
Moore, Hon. T., M.L.C.	Indarra ...	1,021	251 4	7,906 58	31 27	3	5
Barnett, L. T. C.	Walgoodan ...	879	358 4	9,336 20	26 3	2	58
Glengarry Estate	Gnowangerup ...	1,158	203 0	6,865 54	33 49	2	55
Snell, C. & Son	Nangeenan ...	917	201 0	5,356 31	26 39	2	54
Perkins, C. C.	Belka ...	911	480 3	11,890 3	25 50	2	50
Horsman, H. & Sons...	Billharin ...	932	295 0	7,725 30	26 11	2	49
Strange, P. A.	Yarding ...	842	351 0	8,255 42	23 31	2	48
White, R. H. ...	Gnowangerup ...	1,158	336 0	10,394 48	30 56	2	40
Brenner, J. R. & Sons	Corrigin ...	873	940 0	20,776 13	22 6	2	32
Reichelt, E. E.	Burraoppin ...	939	639 0	15,100 0	23 38	2	31
Harris, E. G. S.	Mukinbudin ...	753	378 0	6,340 48	16 46	2	27
Small & King	Shuckleton ...	892	304 0	6,646 12	21 52	2	27
Allen Bros. ...	Kunminlu ...	932	636 0	14,468 46	22 45	2	26
Rudduck, S. A. ...	Coorow ...	1,197	571 0	15,651 50	27 25	2	17
Creagh Bros. ...	Nungarin ...	807	921 0	16,302 13	17 42	2	12
Hughes, J. R.	Minnivale ...	1,051	363 0	8,423 54	23 12	2	12
Scadding, N. A.	Kulln ...	1,131	451 7	1,109 4	24 34	2	10
Manuel, C. J. ...	Mukinbudin ...	753	845 0	5,408 31	15 41	2	5
Anderson Bros.	Dowerin ...	1,040	450 7	9,681 13	21 29	2	4
Stevens, G. K.	South Ghoof ...	850	271 9	4,822 12	17 44	2	4
Kingston, D. W.	Boodarockin ...	717	427 0	6,182 55	14 20	2	1
Nixon & Sons	Kalanlie ...	1,166	3,040 0	64,560 0	21 14	1	49
Haggerty, H. J.	Yarding ...	*	308 0	7,386 45	23 59	...	...
Butcher, O. J.	Pithara ...	*	...	...	...	...	...

* Details not yet complete.

M. T. PADBURY TROPHY RESULTS—1930-33 (INCLUSIVE).

Competitor.	Address.	Average Yield per Acre per Inch of Growing Period Rain.			
		1930.	1931.	1932.	1933.
		bus. lbs.	bus. lbs.	bus. lbs.	bus. lb.
Allen Bros. ...	Central Kunminlin ...	2 11	2 23	...	2 26
Anderson Bros. ...	Dowerin ...	...	...	...	2 4
Atkins, F. M. & J. L. ...	Jouerdine ...	2 41	3 0	...	3 39
Barnett, L. T. C. ...	Walgoolan ...	2 48	2 19	2 34	2 58
Barr, D. F. ...	Shackleton ...	1 49	...	...	...
Beeck, H. O. ...	Gnowangerup ...	...	2 10	...	...
Bishop, H. F. ...	Lake Grace ...	2 1	...	1 59	...
Bothe, B. D. ...	Coorow ...	...	2 2	...	...
Bremner, J. R. & Sons ...	Corrigin ...	1 55	2 10	1 48	2 32
Butcher, O. J. ...	Pithara ...	...	...	2 42	...
Carter, H. R. ...	Three Springs ...	1 55	1 8	...	...
Carter, J. S. & S. T. ...	Benjaberring ...	1 41	1 19	...	...
Clarke, R. W. ...	Carnamah ...	1 22	...	...	...
Cowan, C. W. ...	East Narembeen ...	1 28	...	...	...
Craigie, J. ...	Yarding ...	2 28	...	...	...
Cressh Bros. ...	Nungarin ...	2 20	2 16	1 43	2 12
Cumling, A. S. ...	Carnamah ...	...	1 57	...	...
Cusbert, L. C. ...	Bruce Rock ...	2 44	1 58	...	...
Evans, L. D. ...	Nukarni ...	...	...	2 21	...
Finklestein H. ...	Shackleton ...	...	1 55	...	...
Garnett, J. ...	Gnowangerup ...	...	2 5	...	...
Garrett, G. ...	Ardath ...	1 38	...	...	...
Gillman, F. ...	Bencubbin ...	2 28	...	...	...
Glenagarry Estate ...	Gnowangerup ...	1 52	2 37	1 54	2 55
Haggerty, H. J. ...	Erskin ...	2 51	...	...	...
Hammond, J. D. ...	Kellerberrin ...	2 26	...	...	...
Harris, E. G. S. ...	Mukinbudin ...	...	2 24	...	2 27
Henderson, Late J. H. ...	Gnarwing ...	2 21	...	...	...
Horsman, H. & Sons ...	Bilbarin ...	1 53	2 6	1 5	2 49
Hughes, J. R. ...	Minnivale ...	...	...	...	2 12
Jacob, H. D. ...	Erskin ...	2 9	...	...	...
Kingston, D. W. ...	Boodarockin ...	...	1 46	...	2 1
Leah, J. & Sons ...	Ardath ...	2 45	2 26	...	...
Lohar, W. ...	Borden ...	2 10	...	...	...
Manuel, C. J. ...	Mukinbudin ...	2 44	2 10	2 5	2 5
McLennan Estate ...	Borden ...	...	...	1 55	...
Moore, T., Hon. ...	Indarra ...	...	2 47	2 33	3 5
Morcombe, P. T. ...	Waddy Forrest ...	2 4	...	1 48	...
Nixon & Sons ...	Kalannie ...	1 57	...	...	1 49
Nottage, R. B. ...	Tammin ...	...	2 36	2 21	3 23
Perkins, C. C. ...	Belka ...	...	...	...	2 50
Pascoe Bros. ...	Yalbarin ...	3 14	...	...	...
Prowse, E. W. ...	Doodlakine ...	1 42	...	1 31	...
Reichelt, E. E. ...	Burracoppin ...	...	...	...	2 31
Reichelt, F. W. ...	North Burracoppin ...	2 8	...	...	...
Richards, A. ...	South Caroling ...	...	...	1 9	...
Richardson Bros. ...	Bonnie Rock ...	...	1 33	1 27	...
Riches, H. & Sons ...	Wyalkatchem ...	...	1 56	...	...
Rudduck, M. A. ...	Coorow ...	...	...	...	2 17
Scadding, N. A. ...	Kulin ...	...	...	2 4	2 10
Small & King ...	Shackleton ...	...	...	...	2 27
Smith, C. & A. H. ...	Yalbarin ...	2 38	2 1	...	...
Smith, C. & Sons ...	Yarding ...	2 21	2 29	...	...
Snell, C. & Sons ...	Nangeenan ...	2 29	...	...	2 54
Stevens, G. K. ...	Ghooli ...	...	2 19	...	2 4
Stevenson, K. J. O. ...	Watheroo ...	1 16	...	...	...
Stewart, T. D. ...	Gnowangerup ...	1 28	...	...	...
Strange, P. A. ...	Yarding ...	2 36	2 6	...	2 48
Tibbs, J. A. ...	Bruce Rock ...	2 25	...	...	...
White, R. H. ...	Gnowangerup ...	1 51	2 45	...	2 40
Williams, F. A. ...	Mangwine ...	3 23	2 25	1 34	...

MAIZE FERTILISER TRIALS, 1933-34

H. G. ELLIOTT, Agricultural Adviser, Dairy Branch.

The maize fertiliser trials were continued during the season 1933-34 and were carried out throughout the South-West. The cost was borne jointly by Cuming, Smith & Mt. Lyell Farmers' Fertilisers Ltd. and the Department of Agriculture.

The object of the experiments was to ascertain if results would be obtained similar to those of last season regarding the most economical fertilisers to use for the growing of maize, the soils chosen in each case being those representative of the district.

The fertilisers used and rates per acre were:—

1. Superphosphate 4 cwt. Control.
2. Superphosphate 4 cwt., + sulphate of ammonia 2 cwt.
3. Superphosphate 4 cwt., + sulphate of ammonia 2 cwt.,
+ sulphate of potash 1 cwt.
4. Superphosphate 4 cwt., + sulphate of potash 1 cwt.

Lay-out of Plots.—Each plot was of one-eighth acre and each treatment replicated three times for accuracy, taking into consideration any variation in soil conditions.

MESSRS. BEE BROS., KEYSBROOK.

The trial on the property of Messrs. Bee Bros. was supervised by Agricultural Adviser H. G. Elliott.

Soil.—The type selected was a brown sandy loam overlying clay. This was old "subterranean clover" land originally carrying red gum and jarrah.

Cultivation.—The soil was prepared by spring ploughing and harrowing, the land being re-worked and ploughed prior to planting.

Method of Sowing.—The fertiliser was applied to every third furrow and lightly covered with soil prior to sowing the seed.

Germination.—Good.

Depth of Seeding.—Approximately 2½ to 3 inches.

Rate of Seeding.—30 lb. per acre.

Variety.—"Hickory King."

Distance between Rows.—30 inches.

Weights taken on 2nd February, 1934.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—BEE BROS., KEYSBROOK. SEASON 1934.

On Old Clover Land. Planted 1st November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	£ s. d. 0 10 6	Tons. 6·920	£ s. d. 5 3 10	£ s. d. 4 14 4	100
2, 6, 10 ...	Superphosphate ... 4 "	} 2 5 11	9·480	7 2 2	4 16 3	187
	Sulphate of ammonia 2 "					
3, 7, 11 ...	Superphosphate ... 4 "	} 3 6 5	7·932	5 19 0	2 12 7	114
	Sulphate of ammonia 2 "					
	Sulphate of potash ... 1 "	} 1 10 8	8 246	6 3 8	4 4 0	119
4, 8, 12 ...	Superphosphate ... 4 "					
	Sulphate of potash ... 1 "					

Note.—Fertiliser freight—North Fremantle to Keysbrook—7½d. per cwt. Super at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

L. STILES, GROUP 52, VASSE.

This trial was supervised by Dairy Instructor C. Giles.

Soil.—Varying from a light sandy to red clay loam originally carrying red gum and jarrah, old "subterranean clover" land.

Date of Seeding.—8th November, 1933.

Rows.—27 inches apart.

Rate of Seeding.—20 lb. per acre.

Variety.—"Hickory King."

Method of Planting.—Drills ploughed 4 inches deep, and 36 inches apart. Fertiliser lightly covered prior to seeding.

Weights taken on 9th February, 1934.

Germination.—Generally good but failed in light sand, growth uneven.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—L. STILES, VASSE.

SEASON 1934.

On Land previously growing Sub. Clover. Planted 8th November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	£ s. d. 0 19 6	Tons. 6 893	£ s. d. 5 3 5	£ s. d. 4 3 11	100
2, 6, 10 ...	Superphosphate ... 4 " Sulphate of ammonia 2 "	} 2 5 11	9 252	6 18 9	4 12 10	136
3, 7, 11 ...	Superphosphate ... 4 " Sulphate of ammonia 2 " Sulphate of potash ... 1 "					
4, 8, 12 ...	Superphosphate ... 4 "	} 3 6 5	10 205	7 10 3	4 4 10	148
	Sulphate of potash ... 1 "					
	Superphosphate ... 4 "	} 1 19 8	8 231	6 3 5	4 3 9	119
	Sulphate of potash ... 1 "					

Note.—Fertiliser freight—Picton to Vasse Siding—7½d. per cwt. Superphosphate £4 5s. per ton; sulphate of ammonia £12 12s. per ton; sulphate of potash £19 11s. 6d. per ton.

A. J. KEMP, RUABON.

The trial was supervised by Dairy Instructor C. Giles.

Soil.—Grey sandy loam, new land, originally timbered with red gum, banksia, and jarrah.

Preparation of Land.—Ploughed 8 inches deep in autumn and left open until late spring, then cultivated and reploughed.

Rate of Seeding.—28 lb. per acre.

Variety.—"Hickory King."

Date of Seeding.—15th to 18th November, 1933.

Width of Rows.—27 inches apart.

Weights taken on 20th February, 1934.

General.—Owing to the drought conditions, the experiment was a virtual failure, and 50 per cent. of the plants died off after germination.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—A. J. KEMP, RUABON.

SEASON 1934.

On New Land. Planted 15th November, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	£ s. d. 0 19 0	Tons. 4.1135	£ s. d. 3 1 8	£ s. d. 2 2 8	% 100
2, 6, 10 ...	Superphosphate ... 4 " Sulphate of ammonia 2 "	} 2 5 2	4.3960	3 6 0	1 1 0	170
3, 7, 11 ...	Superphosphate ... 4 " Sulphate of ammonia 2 " Sulphate of potash ... 1 "					
4, 1 ...	Superphosphate ... 4 "	} 3 5 3	5.2010	3 18 0	0 12 9	126
	Sulphate of potash ... 1 "					
4, 1 ...	Superphosphate ... 4 "	} 1 19 1	2.2042	1 13 7	0 5 6 (Loss)	53
	Sulphate of potash ... 1 "					

Note.—Fertiliser freight—Picton to Wonnerup—6d. per cwt. Super at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

R. BURKE, KALGUP.

The trial was supervised by Dairy Instructor C. Giles.

Soil.—Grey sandy loam over clay, originally timbered with jarrah and red gum, old "Subterranean" and "Drooping Flowered Clover" land.

Drainage.—Insufficient.

Date of Sowing.—11th and 12th December, 1933.

Width of Rows.—30 inches apart.

Weights taken on 26th February, 1934.

General.—Birds did a lot of damage. Drought also greatly affected yields. Growth uneven, varying from 3 to 9 feet.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—R. BURKE, KALGUP.

SEASON 1934.

On Land previously growing Sub. and Drooping Clover. Planted 11th December, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15s. per ton.	Worth of Crop per acre less Fertiliser Cost and Freight.	Percentage Yield.
1, 5, 9 (Controls)	Superphosphate ... 4 cwt.	£ s. d. 0 19 0	Tons 6.7116	£ s. d. 5 0 8	£ s. d. 4 1 8	100
2, 6, 10 ...	Superphosphate ... 4 " Sulphate of Ammonia 2 "	} 2 5 2	8.1938	6 2 10	3 17 8	122
3, 7, 11 ...	Superphosphate ... 4 " Sulphate of Ammonia 2 " Sulphate of Potash ... 1 "					
4, 8, 12 ...	Superphosphate ... 4 "	} 3 5 3	9.2200	6 18 4	3 13 1	137
	Sulphate of Potash ... 1 "					
4, 8, 12 ...	Superphosphate ... 4 "	} 1 19 1	7.9680	5 19 6	4 0 5	119
	Sulphate of Potash ... 1 "					

Note.—Fertiliser freight—Picton to Wonnerup—6d. per cwt. Super at £4 5s. per ton; sulphate ammonia at £12 12s. per ton; sulphate potash at £19 11s. 6d. per ton.

W. E. WHITE, WOKALUP.

The trial was supervised by Agricultural Adviser H. G. Elliott.

Soil.—Red to yellow clayey loam, old "Subterranean Clover" land.

Drainage.—Fair.

Preparation.—Ploughed at end of October, harrowed and twice cultivated prior to planting.

Date Planted.—Commenced 26th December, 1933.

Variety.—"Hickory King."

Rate of Seeding.—60 lb. per acre.

Germination.—Very erratic, owing to poor weevil eaten seed, about 50 per cent.

Weight taken on 26th March, 1934.

General.—Crop very uneven in growth, but was in cobbing stage at time of judging.

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER—SEASON 1934.

W. E. WHITE, WOKALUP.

On land previously growing Subterranean Clover.

Planted 26th December, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre, plus Freight	Average Yield per acre.	Worth of Yield per acre at 15/- per ton	Worth of Crop per acre, less Cost Fertiliser and Freight.	Percentage Yield.
1 5, 9 (Control)	Superphosphate ... 4 cwt.	£ s. d. 0 19 8	tons. 8.49	£ s. d. 6 7 4	£ s. d. 5 7 8	100
2, 6, 10 ...	Superphosphate ... 4 " Sulphate of Ammonia 2 "	} 2 6 3	8.917	6 13 9	4 7 6	105
3, 7, 11 ...	Superphosphate ... 4 " Sulphate of Ammonia 2 " Sulphate of Potash 1 "					
4, 8, 12 ...	Superphosphate ... 4 "	} 3 6 6	9.530	7 2 1	3 15 7	112
	Sulphate of Potash 1 "					
	Superphosphate ... 4 "	} 1 10 11	9.190	6 17 10	4 17 11	108
	Sulphate of Potash 1 "					

Note.—Fertiliser freight—Fremantle to Wokalup—8d. per cwt. Superphosphate at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

A. L. STAER, FOREST GROVE.

The trial was supervised by J. H. Nelson, Dairy Supervisor.

Soil.—Varying from a grey sandy loam to light gravel.

Cultivation.—Ploughed on 8th and 9th September, 1933, spring-tyne cultivated on October 21st, and harrowed on October 29th.

Variety.—"Hickory King."

The results were as follow:—

RESULTS OF FERTILISER TRIAL ON MAIZE FOR FODDER.

A. L. STAER, FOREST GROVE.

Planted 30th October, 1933.

Plot No.	Fertiliser per Acre.	Cost of Fertiliser per acre, plus Freight.	Average Yield per acre.	Worth of Yield per acre at 15/- per ton.	Worth of Crop per acre, less Cost Fertiliser and Freight.	Percentage Yield.
1, 5, 9 (Control)	Superphosphate . . 4 cwt	£ s. d. 0 19 4	Tons. 6.040	£ s. d. 4 10 7	£ s. d. 3 11 3	100
2, 6, 10 ..	Superphosphate .. 4 .. Sulphate of Ammonia 2 ..	} 2 5 9	6.201	4 13 3	2 7 6	104
3, 7, 11 ..	Superphosphate 4 .. Sulphate of Ammonia 2 .. Sulphate of Potash 1 ..					
4, 8, 12	Superphosphate .. 4 ..	} 3 5 11	7 650	5 14 9	2 8 10	127
	Sulphate of Potash 1 ..					
	Superphosphate .. 4 ..	} 1 19 6	8 612	6 9 2	4 9 8	143
	Sulphate of Potash 1 ..					

Note.—Freight on fertiliser—Picton to Forest Grove—7d. per cwt. Superphosphate at £4 5s. per ton; sulphate of ammonia at £12 12s. per ton; sulphate of potash at £19 11s. 6d. per ton.

The following table gives the average for the season 1934, and for the two seasons 1933 and 1934:—

Fertiliser per Acre.	Cost of Fertiliser and Freight		Average Yield.		Worth of Yield per Acre at 15/- per ton		Worth of Crop per Acre, less Cost Fertiliser and Freight		Percentage Yield.	
	1934.	1933 and 1934	1934	1933 and 1934	1934.	1933 and 1934.	1934.	1933 and 1934.	1934.	1933 and 1934.
1. Super. (Control) 4cwt	£ s. d. 0 19 4	£ s. d. 0 19 10	tons 6.528	tons. 7 165	£ s. d. 4 17 11	£ s. d. 5 7 6	£ s. d. 3 18 7	£ s. d. 4 7 8	100	100
2 Super. 4 cwt Sulph. Ammonia 2 cwt.	} 2 5 8	} 2 6 2	7 755	10 041	5 16 1	7 10 6	3 10 5	5 4 4	119	140
3 Super. 4 cwt. Sulphate Ammonia 2 cwt. Sulphate Potash 1 cwt.										
4 Super. 4 cwt. Sulphate Potash 1 cwt	} 3 2 7	} 3 5 5	8 29	10.414	6 3 9	7 16 1	3 1 1	4 10 8	127	145
	} 1 19 6	} 2 0 8	7 409	8.311	5 9 6	6 8 11	3 10 0	4 8 3	115	116

Note.—During 1933-34 season, the summer generally was quite unfavourable to heavy yields, owing to extreme dryness, and early in the period high winds from the east, which had a very detrimental effect on growth.

A MODIFIED ROTATION FOR THE WHEAT BELT.

* T. C. DUNNE, Muresk Agricultural College,
and

† F. L. SHIER, Department of Agriculture.

The developmental stage of farming areas is usually characterised by a number of years of continual cropping to the most profitable product. The reason for this is the necessity for obtaining maximum production from a limited area while development is proceeding. Within a few years there becomes evident a decrease in yield and a change is made either by sowing a different crop or by giving the land a period of rest. This is the beginning of a regular system in farming practice, worked out to suit the conditions, which is known as a rotation.

The purpose of a rotation is the maintenance or improvement of fertility and production. The suitability of any rotation for an area will be judged by the degree to which these aims are achieved. The rotation may be of such a nature that one particular crop is of major importance and value with the intermediate crops occupying a definitely minor position. Alternatively, all the different crops may be considered of equal importance when the aim is to maintain productivity in all lines.

It is evident that in any area the suitable rotation will be conditioned by a number of factors which will include climate, soil, nutritive requirements of different crops, manure costs, stock feeding, markets, plant diseases, insect pests and distribution of labour. Further modification may be necessary to cope with more local conditions.

Rotation in Western Australia.

In the wheat areas of this State, farming generally began with continuous cropping. The question of moisture supply was early recognised as of importance and the alternation of crop and bare fallow was very soon adopted. Even under these conditions however, there was a decrease in the yield of crops so that the land was left out of crop for a further year as a resting period. This year served somewhat as a restorative. The advent of sheep into many areas made it necessary to use this resting year as a pasture and thus the present system of fallow, wheat, pasture was developed. This rotation is in fairly general use in the areas in which wheat predominates and in many of the wheat and sheep areas.

The fallow, wheat, pasture rotation was certainly an improvement over the fallow wheat system, and it was considered that this rotation would maintain the fertility and production of the soil. Within recent years, however, it has been realised that in many cases fertility is not being maintained and that production is on the decrease or is not at the level expected. It is probable that in some areas this decrease in fertility has been occurring for many years but that its effect has been masked by the introduction of new prolific varieties of wheat and the dissemination of better methods of farming, which made for higher yields over a period of years.

Deficiencies of Three-Year Rotation.

✓ A study of the three-year rotation (fallow, wheat, pasture) reveals several deficiencies.

* Merchants' Research Officer in Agrostology.
† Agricultural Adviser, Department of Agriculture.

Fallow is undoubtedly a very important part of any system of farming in this State if only for its part in the conservation of moisture. Its benefits, however, are attributable also to a number of other factors which include the destruction of weeds, the building up of soluble nitrogen, increase in available plant nutrients, aeration of the soil, etc. However, it should be remembered that fallow actually adds practically nothing to the soil except perhaps some nitrogen from the atmosphere and the degree to which this is done is directly dependent on the organic matter already existing in the soil. As against this, fallow provides ideal conditions for the rapid decomposition of organic matter and very large quantities are used up in this manner. What fallow actually achieves in connection with plant nutrients is to place these substances at the disposal of the plant in a much more readily available form than would otherwise be the case. In heavy rainfall areas this may even be disadvantageous as soluble nitrogen compounds (nitrates) are very easily leached and with the early heavy winter rains may be washed out of reach of the plants.

A good yielding wheat crop must of necessity be very exhausting. With the conservation of moisture and destruction of weeds of a well worked fallow, and the prolific varieties of wheat now available, the wheat crop is assured providing the level of general fertility in the soil has been maintained reasonably well.

The third or pasture year is undoubtedly the weak portion of the rotation. Providing the destruction of weeds for the wheat crop has been done satisfactorily, the year following provides very little growth and the term pasture is in most cases a misnomer—it is really a stubble period. In such cases the cover will depend on three main sources for introduction. Hard seeds of clover and other annuals which have lain dormant may germinate and, with topdressing, may develop into a reasonably good stand. In some districts and in some soils this gives a fairly satisfactory first year pasture. Apart from this, seeds may be carried into the field by sheep feeding on the stubble or may be blown from neighbouring paddocks. These methods cannot be depended upon for the securing of a good pasture and it is therefore, evident that it cannot be expected that weed free crop will be followed by a good pasture year. Too frequently the so-called pastures consist of a number of stunted plants of cape weed and barley grass which produce very little feed.

With such poor growth, very little organic matter is returned to the soil. The main restoration of this substance is achieved by the return to the soil of the stubble and of plant roots which are left after the removal of the crop. In view of the rapid decomposition of organic matter under fallow conditions the amount returned in this way is not enough for maintenance of this important factor in soil fertility.

Apart from the aspect of maintaining fertility for cropping, the feeding of sheep must be considered. Sheep have become an important part of farming in many areas and will undoubtedly become still more important. They act as useful allies in controlling weeds on fallow and provide a means for the utilisation of stubble. The value of good pasture in the economy of sheep farming can hardly be over-estimated. A good pasture should not only achieve more efficient utilisation of stubble but should serve as a means of conservation for the feeding of sheep during the dry summer months.

The three year rotation is then deficient, mainly through the failure of the pasture year to provide sufficient bulk for the maintenance of adequate soil organic matter or the feeding of any large number of sheep. It is necessary, therefore, to provide for a pasture period which will ensure sufficient growth for the feeding of stock and the renovation of the soil.

A further disadvantage is that barley grass, which is often an important constituent of the pasture under the three-year system, acts as alternate host for take-all and thus allows for its being carried over to the succeeding crop.

Crop Rotation in England.

In the earliest times continuous cultivation and cropping of a piece of land was practised in England. When it was exhausted, another piece was selected until it also became unproductive. Under the manorial system, however, regular rotations on the village farms were enforced. The most common rotation was probably *winter corn, spring corn and fallow*, which enabled the land to be kept fairly clean for a number of years. There was little change until about the middle of the eighteenth century.

About this time roots and red clover were introduced into farming practice and became a part of the Norfolk four-course rotation. This rotation has proved of such value that in many parts of England it still persists unchanged. Furthermore, investigations at Rothamsted have shown that it is well balanced and the fertility of the land is maintained without large expenditure for manures. In view of the fact that it was designed for the production of good crops of wheat on relatively light soils and that it has proven so successful, some features of it are of especial interest to the discussion.

The system of cropping is—*roots, spring cereal (barley), clover, winter cereal (wheat)*. This system embodies the main principles on which all rotations are based. Roots which must be kept free from weeds act as a cleaning crop, spring cereal aids in the distribution of labour throughout the year, and red clover provides a renovating crop. All these factors tend to assure heavy production of the main winter cereal crop of wheat.

While this particular rotation does not apply to the conditions of our wheat areas, the same principles do apply and these can be adapted to suit the peculiarities of climate and soil.

Perhaps the most outstanding feature of the rotation from the viewpoint of farming in this State, is the relatively large amount of organic matter returned to the soil. Roots and clover are fed to stock on the farm and the straw from cereals either consumed or trodden into manure by the stock. Thus every crop provides its quota of organic matter to replace that broken down during the period of rotation. Another feature is the growing of four different crops in order that advantage may be taken of their different nutritive requirements. A third feature is the inclusion of a leguminous crop which will stimulate considerably the activity of bacteria and fungi in the soil.

Modification of Three-Year System in Western Australia.

The application of the principles of the English rotation makes it clear that improvement is needed in the amount of organic matter returned to the soil. This can best be done by a good pasture, and a leguminous pasture should be most suitable.

Under the three-year system, however, a good pasture is hard to obtain. To obtain a good stand of clover in one year would necessitate a very heavy rate of seeding which would in most cases be unprofitable. On the other hand, relatively light sowings of clover will give good stands in two or three years providing annual topdressing with superphosphate is practised. Apart from the question of soil improvement, clover is under our conditions the best pasture from many viewpoints. It is more or less obvious, therefore, that the first step in strengthening the rota-

tion is the improvement of the pasture period by the use of clover and by allowing the pasture to remain as such for a period of years.

The number of years of continuous pasture will depend on several factors. With a light sowing many clover pastures enter the period of best productivity about the third year and will remain productive for some years. There is, however, a tendency towards a natural cycle of legumes and grasses (including cereals). On an impoverished soil, clover will spread rapidly and become dominant within a short time. A few years of good clover, however, build up the soil fertility to such an extent that conditions are made more suitable for grasses which are enabled to compete successfully with the clovers. The clover will be observed to be going back and the grasses improving. This indicates the ideal stage for breaking up the pasture and cropping the cereals in order that they may derive the benefit of the increased fertility. In general, however, the minimum period for clover pasture will be three or four years and the maximum six or seven years.

With the lengthening of the pasture period to four years and no other change in the rotation, good crops would probably be secured by a rotation consisting of bare fallow, wheat, four year pasture, but this would give only one-sixth of the area under crop each year. This proportion of crop is too low for the usual wheat farming conditions. However, farming practice in the early stages of development showed that when the fertility of the soil was reasonably high, alternate fallow and crop would produce good yields for a period of years.

A rotation embodying the points discussed above is suggested as an improvement in the direction of better maintenance of fertility and yields. No definite rotation can be laid down which will suit all needs in all areas, but rather are the principles to be followed and adapted to suit individual requirements. *The rotation suggested consists of continuous clover pasture for several years followed by alternate fallow and crop for a further period of years.*

The experimental fallow versus non-fallow plots at Chapman State Farm sown under the three year system, have averaged over the period 1929-32, 16 bushels 27 lbs. and 15 bushels per acre respectively. When, in 1933, these plots were transferred to an area of similar soil which had been under pasture since 1927, the respective yields were 28 bushels 21 lbs. and 32 bushels 5 lbs. per acre. The average yield from all these latter plots was 30 bushels 13 lbs. per acre, which is considerably higher than has previously been obtained from this paddock or from any similar soil on this farm. This improvement can only be attributed to the beneficial effect of the pasture period.

Heavier Rainfall Areas—Over 16 inches per annum.

The pasture in these areas should be early subterranean clover. Good growth will usually be obtained for at least five years, the last three years being the most productive. With the higher rainfall, fallow is not as essential for conservation of moisture as in the drier districts. Moreover, after a long pasture period the soil nitrogen content should be high, so that for the first cropping following pasture, fallow may be omitted, the land being cropped immediately after ploughing. The two succeeding crops should preferably be sown after fallow.

The rotation for each paddock would be *five years pasture, crop, fallow, crop, fallow, crop*, and the subdivision of the farm—

Pasture.	Crop.	Fallow.	Total area.
500	300	200	1,000

This division assumes units of 100-acre paddocks in order that each year one paddock is changed from crop to pasture and one paddock from pasture to crop.

In some of the higher rainfall areas, oats are often sown directly after wheat on fallow. To include this practice the rotation could be modified to *five years pasture, crop, fallow, crop (wheat), crop (oats)*.

Again, where sheep raising is more important than cropping, the rotation may be made shorter to fill this need for a smaller proportion under crop. Such a system may be *five years pasture, crop, fallow, crop*, giving the division—

Pasture.	Crop.	Fallow.	Total area.
500	200	100	800

It will be realised, of course, that in such areas it may be advantageous to lengthen the period of pasture. In this case, of course, the proportion under crop would be decreased. As an example, a seven year pasture period followed by crop, fallow, crop, would give only one-fifth cropping, the proportions being—

Pasture.	Crop.	Fallow.	Total area.
700	200	100	1,000

Alternation of wheat and oats in the cropping is desirable and in the cases where the larger amount of cropping is done, this practice should be followed. The alternation of cereals is not as exhausting as cropping wholly to wheat, advantage being taken of the differing nutritive requirements of the crops. Furthermore, considerable good may be done in the control of plant diseases.

With the advantage of the cleaner fallows and crops which should be procured under this system, it may be possible to substitute a crop of peas for a fallow. This, of course, will apply mainly in the higher rainfall areas and will be dependent on the amount of labour available.

Subterranean Clover.

In the rainfall areas above 16 inches per annum, early sub-clover should be the main legume and pasture constituent—in fact these areas are considered to constitute the early sub-clover belt. A few comments on this clover are deemed advisable.

At present four main strains of subterranean clover are recognised.* Tabulated in order of earliness of maturity, they are as follow—

1. Dwalganup or First early strain.
2. Daliak or Second early strain.
3. Midseason strain.
4. Brunswick or Late strain.

The various strains of sub-clover are described and discussed in Leaflet No. 225 of the Department of Agriculture.

It must be emphasised that there is just as much difference and importance in the period required for maturity of the different strains of sub-clover as there is between the different varieties of wheat.

The main varieties on the market at present are First early strain and Midseason strain. The former flowers and matures seed about one month earlier than the latter. Except where the rainfall approximates 25 inches per annum, Midseason sub-clover has practically no possibility of success. Where superphosphate has been applied the failure of most farmers to succeed with sub-clover can be attributed to the use of the wrong variety. First early sub-clover has been grown successfully at Muresk Agricultural College (rainfall 17 inches per annum) for about seven years and by distributing burr from the original area sown, has been established over a considerable portion of the farm. Only isolated plants of the Midseason strain have persisted in the wetter patches. It cannot be emphasised too much that

farmers in the areas under review intending to sow sub-clover should insist on the First early (Dwalganup) strain.

Eggs of insect pests of sub-clover, clover springtail (lucerne flea) and red-legged earth mite, are readily distributed on clover burr. Where the clover is being sown, therefore, care should be taken to procure cleaned seed and not burr in order to avoid the introduction of these pests.

It should also be emphasised that topdressing with superphosphate is essential to success.

Lighter Rainfall Areas—Below 16 inches per annum.

While experience may show that first early sub-clover will grow successfully in some areas with less rainfall than 16 inches per annum, it is probable that burr trefoil or cluster clover will be the main pasture constituents. Burr trefoil is capable of excellent growth, particularly on the heavier soils. However, its spiny seed burrs which become attached to the wool are a disadvantage. Cluster clover, normally, does not produce the same bulk of feed, but is better suited than burr trefoil to the lighter soils.

In the lighter rainfall areas, cropping is usually more important than sheep raising. For this reason a suitable rotation must allow for a fair proportion of the land under crop each year. Further, fallow is essential for the conservation of sufficient moisture for the production of good cereal yields in these areas.

The basic rotation suggested is *four years pasture, fallow, crop, fallow, crop, fallow crop*, giving the proportions—

Pasture.	Fallow.	Crop.	Total area.
400	300	300	1,000

Modifications of the nature previously discussed may, of course, be necessary to meet the requirements of individual farmers or of differing soils.

How to Begin the Rotation.

It is not possible to change over immediately from one system of farming to another. It should be realised that in the rotation suggested above, the pasture is being treated more or less as a crop, which means that a change is being made to a more intensive system of farming. The change must be made gradually but the introduction of two major features new to some areas will be necessary.

1. Subdivision.

The scheme outlined above assumes units of 100-acre paddocks. This is necessary for the even production of both crop and pasture. On this assumption each year 100 acres is changed over from crop to pasture and 100 acres of old pasture is put into cropping. The effect of this will be to have areas under crop in different stages of the rotation, namely one under its first crop, one under its second crop and one under its third crop of the rotation. With the pasture, one paddock has first year pasture, one second year pasture, one third year pasture and so on.

While the subdivision may be considered a disadvantage for cropping, experiments have shown that better results are secured by grazing paddocks in rotation. If the area is fed off rapidly and the stock moved more often, the pasture has ample time to recuperate and selective grazing by the stock is reduced to a minimum. From this point of view it may later be found that further subdivision is advantageous.

2. Topdressing with Superphosphate.

The rotation aims to include clover as the dominant pasture constituent. For good growth and spreading of clover, topdressing with superphosphate is essential. It will, therefore, be necessary to super. the pasture every year at the rate of 50-100

lbs. per acre to obtain maximum returns. This will be amply repaid by the increased sheep carrying capacity of the pasture apart from a lessening of nutritional diseases with the stock.

With these points in mind a beginning can be made. The paddock most run down should be first put to clover pasture. This is best done by broadcasting clover seed with the final crop. This crop may be cut for hay or harvested for grain and the clover will form seed underneath.

The rate of seeding will be about 2 lbs. of cleaned seed free from burr per acre for sub-clover and about 1 lb. per acre for burr trefoil and cluster clover. If not sown with the crop, the clover seed should be broadcast the following year with the advent of the first winter rains. The next year another area will be sown in a similar manner. As more pasture is sown it will be necessary to change the best of the remaining paddocks over to alternate bare fallow and crop in order to maintain the area under crop. Depending on the period adopted for pasture, at the end of four or five years the pasture paddocks will be changed to alternate fallow and crop and the rotation is under way.

After a few years it should be possible to collect enough seed in burrs from the older-established pastures by raking during the summer for the sowing of the new pastures. As early sub-clover buries its seed, it will be necessary to cultivate before raking, in order to bring the seed to the surface. As far as is possible, burr should be collected from paddocks free from insect pests of clover, as the eggs of these are often attached to the burrs and so become distributed.

Benefits of the Rotation.

The rotation as outlined above will retain all the desirable effects of fallow and will allow of the maximum benefit from this practice. Experience from the rotation experiment at Merredin Experiment Farm shows that weeds will be particularly well controlled by the alternate fallow and crop with considerably less cultivation than was the case under the three-year system.

Clover springtail and red legged earth mite have become, in many districts, serious pests of clover. The more effective control of weeds will limit the hosts for these pests during the cropping period and the following pasture should be relatively free from trouble of this nature in the early years, providing clean seed is sown.

The pasture years under clover will act as a useful buffer between cropping periods and will for this reason help control plant diseases attacking wheat. In addition, the large amounts of organic matter returned to the soil during these years will tend towards increased yields in the following crops. Soil fertility is to a great extent dependent on the bacterial activity of the soil and this may be greatly increased by the addition of organic matter, particularly that of high nitrogen content. The organic matter returned from a clover pasture, whether obtained from grazing sheep or the residual clover roots, is rich in nitrogen. Furthermore, organic matter makes the soils more friable and more easily worked.

Summary and Conclusion.

A modification of mixed farming management in wheat and sheep areas is discussed and a system of rotation is outlined which will involve more intensive farming and better control of many of the difficulties in wheat farming. The system advocated takes advantage of the benefits of the fallow-wheat rotation in controlling weeds and diseases and economy of cultivation, and ensures a maximum production of pasture of high feeding value.

A scheme is proposed for the layout of a mixed farming proposition to take advantage of the modified system.

ROTATIONAL GRAZING TRIALS.

Season 1933-1934.

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and

H. G. ELLIOTT, Agricultural Adviser (Dairy Branch).

During the last three years considerable attention has been paid to the possible value of rotational grazing in Western Australia in raising the stock-carrying capacity of our pasture lands. As far as this State is concerned, the limiting factors have proved to be three-fold—

1. The uneven distribution of the annual rainfall;
2. The general infertility of soils from the pasture point of view;
3. The botanical composition of existent pastures, which are mainly leguminous.

The first point is shown in the following Table (1) giving the average monthly rainfall for the eight centres where these trials have been conducted, and also the actual monthly rainfall during the season 1933-34.

TABLE 1.—*Monthly Rainfall at Experimental Centres.*

Month.	York.		Kendenup.		Pinjarra.		Bunbury.		Harvey.		Serpentine.		Kullup.		North Dandalup.	
	1933.	Average 30 years.	1933.	Average 32 years.	1933.	Average 34 years.	1933.	Average 36 years.	1933.	Average 36 years.	1933.	Average 36 years.	1933.	Average 36 years.	1933.	Average 36 years.
Jan. . .	25	30	171	55	67	35	67	43	104	42	78	37	57	42	55	51
Feb. . .	19	44	15	67	24	41	18	53	25	54	49	43	30	29	32	27
Mar. . .	125	63	190	111	49	85	37	99	34	78	50	81	124	111	58	113
Apr. . .	45	82	149	179	127	188	182	171	123	179	115	168	80	213	160	210
May . .	391	235	289	313	517	547	419	521	569	571	567	607	336	339	541	678
June . .	301	332	673	320	1,105	753	741	718	809	811	879	775	784	887	982	708
July . .	204	345	16	395	577	727	424	687	660	785	523	802	359	416	545	888
Aug. . .	212	285	249	331	662	622	495	527	515	665	480	599	379	810	592	657
Sept. .	115	161	244	300	401	394	327	364	517	450	327	424	232	298	408	477
Oct. . .	221	108	401	243	491	259	368	241	381	291	426	245	275	151	452	305
Nov. . .	5	41	162	107	46	93	22	99	33	108	45	84	39	70	7	102
Dec. . .	Nil	47	125	83	27	60	14	57	45	59	Nil	52	24	9	19	45
Total	1,663	1,766	2,784	2,504	4,093	3,804	3,114	3,580	4,105	4,033	3,533	3,917	2,728	2,366	3,851	4,261

It will be seen that, with few exceptions, no useful rainfalls occur during the six months from November to April each year.

The whole of the cost involved in carrying out the eight trials reported herein has been generously borne by Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., and Nitrogen Fertilisers Pty., Ltd., while the planting and supervision have been carried out by these companies' joint Field Officer, Mr. G. N. Lowe, co-operating with officers of the Department of Agriculture.

The trials were inaugurated in 1931-32, but no standard plan was adopted at that time, and, as it was considered that the results from single trials would yield little reliable information, all rotational grazing experiments were carried out on a uniform plan as from the 1933-34 season.

The object of the trials reported below is to determine—

- (1) whether added grazing can be obtained from an addition of sulphate of ammonia to the superphosphate ordinarily used; and
- (2) what quantity of sulphate of ammonia, if any, is desirable.

D. Bevan & Sons, Serpentine.

The following fertilisers were used:—

Plot 1—Superphosphate (control)	..	..	2 cwt. per acre in autumn.
„ 2—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	1 „ „ „
„ 3—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	2 „ „ „

The soil consisted of a sandy to sandy loam over-lying a clay to clayey gravel.

The whole area was sown originally in 1932-33 with a mixture of perennial ryegrass, cocksfoot and white clover.

During the season 1933-34 perennial ryegrass had established itself well, but the cocksfoot and white clover were only evident in limited numbers. Associated with the ryegrass, however, were other annual grasses, such as soft brome (*B. hordeaceus*), sterile brome (*B. sterilis*), silver grass (*Festuca myuros*), etc., along with subterranean clover and other annual minor types. This pasture contained about 70 per cent. of grasses.

Table 2 gives the results for 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percent-age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent-age Net Return.
1. Super. (Control)	138	100	£ s. d. 0 9 9	£ s. d. 2 9 6	£ s. d. 1 19 9	100
2. Superphosphate Sulph. Ammonia	251	182	1 3 0	4 10 0	3 7 0	167
3. Superphosphate Sulph. Ammonia	277	200	1 16 2	4 18 9	3 2 7	157

More grazing days would have been obtained had not the plots been allowed to get ahead of the stock towards the end of the spring. The mower was used later, but not until the pasture plants had commenced blooming, consequently full use was not made of the grazing provided. These plots were grazed by cows.

F. Walton Rowe, Kenderup.

Originally this trial was sown with perennial ryegrass, cocksfoot and white clover, and included in the manurial treatments. Monaphos No. 2 and nitro chalk v. superphosphate at 2 cwt. plus 200 lbs. of sulphate of ammonia per acre, the plant foods per acre being balanced.

After two years the concentrates were no longer available, when the treatments were altered to superphosphate (control) v. superphosphate and sulphate of ammonia in autumn at varying rates of sulphate of ammonia per acre.

The following fertilisers were used during 1933-34:—

Plot 1—Superphosphate (control)	..	..	2 cwt. per acre in autumn.
„ 2—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	0½ „ „ „
„ 3—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	1 „ „ „
„ 4—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	1½ „ „ „
„ 5—Superphosphate +	..	..	2 „ „ „
Sulphate of ammonia	..	..	2 „ „ „

Perennial ryegrass and white clover were well established during the season 1933-34, growing in association with other annual grasses and clovers with very little cocksfoot present.

Table 3 gives the results for the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows. *	Percentage (Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
1. Super. (Control)	464	100	£ s. d. 0 10 0	£ s. d. 8 5 9	£ s. d. 7 15 9	100
2. Superphosphate Sulph. Ammonia	405	97	0 16 9	7 5 0	6 8 3	82
3. Superphosphate Sulph. Ammonia	577	124	1 3 0	10 6 0	9 2 6	117
4. Superphosphate Sulph. Ammonia	474	102	1 10 3	8 9 3	6 19 0	89
5. Superphosphate Sulph. Ammonia	498	107	1 16 8	8 17 10	7 1 2	90

* Based 1 cow = 8 sheep.

Plot No. 3 probably was influenced by the residual values from the previous season's trial, as the plot originally was fertilised with 2 cwt. superphosphate and 200 lbs. sulphate of ammonia per acre during the period in which the nitro chalk and monamphos were under trial.

The above plots were grazed by sheep.

Homebush Stud Farm, Cookernup.

This plot originally was established in 1931-32 season with a perennial ryegrass, cocksfoot, white clover mixture, and during the years 1931-32 and 1932-33 the following results were obtained from the different manurial treatments:—

		1931-32.	1932-33.
Superphosphate (control) .	2 cwt. per acre	100%	100%
Autumn 1 cwt.			
Spring 1 cwt.			
Superphosphate	2 cwt. per acre—autumn	134%	129%
Sulphate of ammonia ..	1 " "		
Superphosphate	2 " " "	103%	114%
Autumn 1 cwt.			
Spring 1 cwt.			
Sulphate of ammonia ..	1 " "		
Autumn ½ cwt.			
Spring ½ cwt.			

From the above it was decided that the spring dressing is only desirable when closing the paddocks for meadow hay in the late spring; consequently this grazing trial was brought into line with the others, using an autumn topdressing only.

During the autumn, 1933, the following fertilisers were applied:—

Plot 1—Superphosphate (control)	..	..	2 cwt. per acre.
„ 2—Superphosphate +	..	..	2 " "
„ Sulphate of ammonia	..	..	1 " "
„ 3—Superphosphate +	..	..	2 " "
„ Sulphate of ammonia	..	..	2 " "

The pasture consisted mainly of subterranean clover with annual grasses and minor clovers.

Table 4 gives the results for 1933-34:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percent-age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent-age Net Return.
1. Super. (Control)	267	100	£ s. d. 0 9 9	£ s. d. 4 15 4	£ s. d. 4 5 7	100
2. Superphosphate Sulph. Ammonia	417	156	1 3 0	7 8 10	6 5 10	146
3. Superphosphate Sulph. Ammonia	463	170	1 16 2	8 5 4	6 9 2	150

The above plots were grazed by cows.

N. F. Lee, North Dandalup.

The composition of this pasture was a mixture of kikuyu grass and subterranean clover.

The same type of fertilisers were used, as in the previous trial, for both seasons 1932-33 and 1933-34.

Table 5 gives the results of the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percent-age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent-age Net Return.
1. Super. (Control)	86	100	£ s. d. 0 9 9	£ s. d. 1 10 9	£ s. d. 1 1 0	100
2. Superphosphate Sulph. Ammonia	119	140	1 3 0	2 2 6	0 19 6	93
3. Superphosphate Sulph. Ammonia	171	200	1 16 2	3 1 1	1 4 11	120

The conditions for growth during the early portion of 1933-34 season were distinctly unfavourable, owing to the comparatively low rainfall and extremely cold conditions which retarded the growth of the pasture.

The plots were grazed by cows.

W. G. Burges, York.

This experiment consisted of three plots of 2 acres each, which, after a thorough preparation, were seeded down on 27th May, 1933, with 6 lbs. of *Phalaris tuberosa* per acre, and an excellent germination was obtained.

Owing to the slowness of establishment of *Phalaris tuberosa* during its first season, it was realised that nothing exceptional in the way of grazing could be obtained from *Phalaris tuberosa* until after its first season, if it were able to persist through the dry summer months.

Naturally, therefore, the grazing afforded was very largely from annual grasses with the minor clovers.

Following a very cold, unfavourable winter period, extreme summer conditions obtained, and despite every care a very small percentage of *Phalaris* plants persisted.

The fertiliser treatment was the same as for the previous trials.

Table 6 gives the results for the first season, 1933-34:—

Fertiliser and Plot No.	Grazing Days— Cows. *	Percent- age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days— 2, 6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent- age Net Return.
1. Super. (Control)	69	100	£ s. d. 0 9 9	£ s. d. 1 4 6	£ s. d. 0 14 9	100
2. Superphosphate Sulph. Ammonia	148	210	1 3 0	2 12 10	1 9 10	200
3. Superphosphate Sulph. Ammonia	199	286	1 16 2	3 11 0	1 14 10	233

* One cow = eight sheep.

The above plots were grazed by sheep.

Captain L. Craig, Dardanup.

After a thorough soil preparation in the early winter, 1932, the plots were seeded with perennial ryegrass (certified), cocksfoot, and white clover, the latter, however, being eliminated by the clover springtail and red mite.

During the following summer a good growth of perennial ryegrass persisted with only a little cocksfoot, the grazing being obtained almost solely from the perennial ryegrass.

In the 1933-34 season the pasture consisted of perennial ryegrass and subterranean clover with other annual minor grasses and clovers.

The same fertiliser treatment was used as in the previous plots.

Table 7 gives the results for season 1933-34:—

Fertiliser and Plot No.	Grazing Days— Cows.	Percent- age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days— 2, 6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent- age Net Return.
1. Super. (Control)	239	100	£ s. d. 0 9 9	£ s. d. 4 5 4	£ s. d. 3 15 7	100
2. Superphosphate Sulph. Ammonia	251	105	1 3 0	4 9 7	3 6 7	88
3. Superphosphate Sulph. Ammonia	270	117	1 16 2	4 19 7	3 3 5	84

The above plots were grazed by cows.

Owing to the experimenter's home having been destroyed by fire during the period of the trial, farm routine was badly upset, and proper attention to the conditions laid down for the experiment could not be given. Consequently all the growth available was not grazed during the end of the spring, and was later mown when in seed head.

The aftermath was grazed by sheep, but no record of this was made. The number of grazing days, therefore, was considerably reduced.

Estate of J. Staniforth-Smith, Kulikup.

This experiment was established in 1932, but proper attention as to rotational grazing was not given until the 1933-34 season.

The pasture consisted of perennial ryegrass with other annual grasses and some clovers.

The same fertiliser treatment was given as for the previous experiments, with the following results:—

TABLE 8.—*Results, 1933-34 Season.*

Fertiliser and Plot No.	Grazing Days—Cows.*	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
1. Super. (Control)	42	100	£ s. d. 0 9 9	£ s. d. 0 15 0	£ s. d. 0 5 3	100
2. Superphosphate Sulph. Ammonia	191	451	1 3 0	3 8 3	2 5 3	500
3. Superphosphate Sulph. Ammonia	230	545	1 16 2	4 2 2	2 6 0	520

* Grazing was carried out by sheep. Based 1 cow = 8 Sheep.

Summarising the above results, Table 9 gives the average production, etc., for the 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percentage Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percentage Net Return.
1. Super. (Control)	186.4	100	£ s. d. 0 9 9	£ s. d. 3 6 7	£ s. d. 2 16 10	100
2. Superphosphate Sulph. Ammonia	279.1	150	1 3 0	4 19 8	3 17 8	137
3. Superphosphate Sulph. Ammonia	302.4	167	1 16 2	5 8 0	3 11 10	125

On all trials, lime and potash strips were used, but at one farm only was any definite result obtained, this being from potash, where the sheep showed a definite preference for the area where potash had been applied. No noticeable difference observationally or from any preference on the part of the stock was obtained from the limed strips.

Paterson Bros., Pinjarra.

This trial is not included in the above, owing to the failure of the pasture plants during the first season.

In 1933 it was decided to sow down the area with kikuyu grass, which gave promise of persisting through the summer. The planting was carried out in the spring, giving approximately 100 per cent. "strike."

The grazing results shown in the table below are, therefore, practically obtained from winter annuals and, to some extent, Guildford grass.

Tab'c 10 shows results for 1933-34 season:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percent-age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent-age Net Return.
1. Super. (Control) 2 cwts. per acre (Autumn)	61	100	£ s. d. 0 9 9	£ s. d. 1 1 8	£ s. d. 0 11 11	100
2. Super. 2 cwts., Sulph. Ammonia 1 cwt. (Autumn)	48	78	0 16 5	0 17 5	0 1 0	8
3. Super. 2 cwts., Sulph. Ammonia 1 cwt. (Autumn)	61	100	1 3 0	1 1 8	*0 1 4	...
4. Super. 2 cwts., Sulph. Ammonia 1½ cwts. (Autumn)	61	100	1 9 8	1 1 8	*0 8 0	...
5. Super. 2 cwts., Sulph. Ammonia 2 cwts. (Autumn)	71	112	1 16 2	1 5 4	*0 10 10	...

* Loss.

Table 11 shows compiled results of fertiliser applications to pastures in the South-West:—

Fertiliser and Plot No.	Grazing Days—Cows.	Percent-age Grazing Days.	Cost of Fertiliser, Freight, etc.	Value of Grazing Days—2/6 per week per Cow.	Net Return over Cost Fertiliser, Freight, etc.	Percent-age Net Return.
1. No Fertiliser ...	56	100	£ s. d. ...	£ s. d. 1 0 0	£ s. d. 1 0 0	100
2. 1 cwt. Super. (Autumn)	148	263	0 4 11	2 12 10	2 7 11	240
3. 2 cwts. Super. (Autumn)	186	330	0 9 9	3 6 7	2 16 10	285
4. 2 cwts. Super., 1 cwt. Sulphate Ammonia (Autumn)	279	500	1 3 0	4 19 8	3 16 8	385
5. 2 cwts. Super., 2 cwts. Sulphate Ammonia (Autumn)	302	540	1 16 2	5 8 0	3 11 10	360

Figures for *no fertiliser* and 1 cwt. superphosphate per acre were obtained from topdressing results for four years, 1923-1926, over 65 plots. Results were published in Leaflet No. 208—"Pastures," by P. G. Hampshire, Department of Agriculture, Perth.

CONCLUSIONS.

Although the trials have been conducted on standard lines for only one year, the results have been fairly uniform over the seven centres so that it is believed that tentative conclusions of at least one aspect can be drawn.

- (a) The need in Western Australia is for a supply of nutritious fodder during early winter after the soil supply of nitrogen, which has been made available during the summer by nitrification, has been exhausted.

Superphosphate alone will not give this early bite, particularly where annual clovers only form the bulk of the pasture.

In order to secure this early bite, a nitrogenous fertiliser seems of special value.

In all the experiments sulphate of ammonia has been used to supply the required nitrogen.

(b) Table 9 shows that there is an average of 50 per cent. increase in grazing by an application of 1 cwt. sulphate of ammonia with superphosphate as a base. Where the sulphate of ammonia is increased beyond 1 cwt., the increase is at a diminishing rate.

(c) Table 11 shows that in addition to greater dressings than 1 cwt. sulphate of ammonia returning lesser rates of increase in grazing, the profit from greater weights than 1 cwt. per acre rapidly decline. This probably is due to the depressing effect of large applications of nitrogenous fertiliser to leguminous pastures, and is greater on the average pasture in Western Australia by reason of the fact that in only a few instances are perennial grasses existent.

These conclusions are for non-irrigated pastures, as under irrigation conditions it is known that larger applications, spread over the months during which irrigation water is applied, are profitable.

(d) On all plots dressings of potash and lime were applied.

In no instance was a greater growth noticed on any limed plot, but lime should not be regarded as a fertiliser but as a corrective for soil acidity, and, where repeated applications of sulphate of ammonia are being made, care should be taken that the lime content of the soil is maintained.

On one trial the sheep showed a definite preference for the area fertilised with potash, although any increase in bulk was not noticeable to the eye.

Further trials are being made with potash fertilisers on pasture.

SORGHUM, SUDAN GRASS, AND JOHNSON GRASS POISONING.

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The three names given above are somewhat misleading, as Sudan Grass and Johnson Grass are really Sorghums themselves, being *S. halepense* var. *sudanense* and *S. halepense* respectively. For convenience, however, these two are kept separate from the remainder of the species of agricultural importance which are commercially grouped as Sorghums.

Sudan Grass in particular has become quite an important annual summer crop in this State, for grazing as well as hay and silage purposes, but from time to time this grass has been suspected of poisoning stock.

The following extracts should help to elucidate the position regarding the toxicity of the various species:—

1. Sorghum—Sudan Grass Hybrids—A. W. S. Moodie. *Agricultural Gazette*, N.S.W., Oct. 1, 1929:—

"It is well known that Sorghum should be allowed to flower before being fed to stock, whereas pure Sudan grass can be fed at any stage of growth. It was therefore concluded, and field observations have confirmed the opinion, that hybrids produced by accidental interpollination were likely to prove as toxic during their early stages of growth as young sorghum plants.

With a view to obtaining definite information, tests were carried out on Sorghum-Sudan Grass hybrids.

Local and overseas investigations concerning sorghum have shown that—

- (a) It is quite safe when it reaches the flowering stage.
- (b) There is danger from poisoning, especially in the case of large stock, from young growth or 'second growth' coming away after the main crop has been harvested.
- (c) Young growth that is frosted, or stunted growth caused by drought conditions, is often highly toxic.
- (d) Cutting the immature crop and allowing it to wilt for at least twenty-four hours before feeding is often effective in rendering the material harmless, but sometimes mortality will occur even when this precaution has been taken."

A general summary of the article is as follows:—

Pure Sudan Grass is perfectly safe to feed to stock at any stage of growth.

Sorghum should be allowed to reach the flowering stage before being grazed or fed to stock.

Hybrids, the progeny resulting from the crossing of Sudan Grass and Sorghum may contain much more hydrocyanic acid than Sorghum.

2. Hydrocyanic acid content of Sorghum-Sudan hybrids—A. A. Ramsay, *Agricultural Gazette*, N.S.W., Oct. 1, 1929.

Estimation of hydrocyanic acid in various samples gave the following results:—

The quantity containing the minimum fatal dose for sheep—

Pure Sudan Grass, 1,333 lbs.

Pure Saccaline Sorghum, 4.4 lbs.

Hybrids, 1.2 to 133 lbs.

Most of the hybrids were evidently more toxic than the Sorghum parent with the pure Sudan Grass not containing sufficient hydrocyanic acid to be dangerous.

3. Poisoning of cattle by Sorghum and Allied Plants. H. Wenholz—*Agricultural Gazette*, N.S.W., Feb. 1, 1922.

"From a comparison of the amount of prussic acid set free from given quantities of Sorghum and Sudan Grass with the amount of combined acid required to produce fatal results, the quantity of fresh, young Sudan Grass which an animal would need to eat for the effect to be fatal has been estimated at 19 lbs. and of the fresh young Sorghum at 7½ lbs. These figures are based on the assumption that all the acid is set free in the animal's stomach. Fortunately, however, conditions are against the complete liberation of the acid, and the amounts mentioned have been eaten, and can be eaten, with impunity.

"Investigation and ordinary farm practice have shown that, when cured as fodder or hay, or even so long as they have been allowed to wilt for 24 hours after being cut, Sorghum and Sudan Grass may usually be fed to stock with

safety. It has been proved that comparatively large quantities of these fodders may be fed thus without producing any signs of poisoning. This apparent harmlessness of cured or wilted Sorghum and hayed Sudan Grass is attributed to the destruction of the activity of the enzyme on being dried. Another general experience has been that Sudan Grass or Sorghum injured by drought or other adverse climatic conditions contains a larger quantity of prussic acid than when the crop has made vigorous normal growth. This point has been verified by the results of actual chemical analysis, more than twice the quantity of prussic acid being found in Sorghum stunted by drought or injured by frost than in Sorghum of normal growth.

"On the other hand it has been shown that Sorghum grown on poor soil contains less prussic acid than that grown on a rich soil, especially if the poor soil is low in nitrates.

"That the percentage of prussic acid in Sorghum decreased steadily from the time the plant begins growth until it ripens seed (presuming the growth has been normal) is generally agreed by both chemists and farmers."

In America and New South Wales evidence suggests a relationship between climate and toxicity, and some American chemists consider that varietal difference is probably of more significance in the determination of the amount of prussic acid in Sorghum than are conditions of growth.

4. E. Breakwell—Grasses and Fodder Plants of New South Wales (1923).

"Although no direct reports have been received in this State concerning the poisonous action of Johnson Grass, that hydrocyanic or prussic acid exists in the grass has been proved in California. Most sorghums are poisonous in character, and as this grass belongs to the Sorghum family, it is well to bear in mind the conclusion of the Brisbane chemist, Brunnich:—All fodder plants related to Sorghum must be used with discretion in either the green or the dried state, and should not be given in large amounts to animals which have fasted for some time."

"Investigations were carried out in 1920-21 by the Stock Branch, Department of Agriculture, by feeding Sudan Grass at all stages of growth, and they were attended by entirely negative results. Thousands of acres have since been pastured by sheep and cattle without harmful effects."

"The following warning has been issued by the Stock Branch of the Department of Agriculture in relation to this subject:—

1. Sudan Grass is most likely to be harmful to cattle when immature or stunted through drought.

2. If cattle are put on Sudan Grass, care should be taken that they are only put on it for a short time at first.

3. When cut and dried it is unlikely to be harmful.

4. So far as prussic acid is concerned, the grass may be safely grazed by horses or pigs, and is unlikely to be as dangerous to sheep as to cattle."

"Sorghum poisoning is of fairly common occurrence in Australia, and has also been reported from America and Egypt. The latest investigations in the prussic acid content of Sorghums have led to the following conclusions:—

1. When Sorghums are grown on poor infertile soils, added nitrogen may slightly increase the amount of hydrocyanic acid in the plant. With a fertile soil and abundant nitrogen this effect may not be produced.

2. During the first three or four weeks of the plant's life, the prussic acid is concentrated in the stalks. Then it rapidly disappears there, but apparently persists in the leaves in decreasing percentages until maturity.

3. Climate and variety may be more important factors than soil nitrogen in determining the amount of acid in the plant.

"The mature Sorghum is harmless and can be fed with perfect safety."

5. P. Ryan—Summer Fodder Crops.—*Journal of Agriculture*, Vic., Sept., 1929.

"While Sudan Grass belongs to the Sorghum family, there is much less danger of prussic acid poisoning from pasturing it than is the case with other Sorghums. Indeed, provided that the seed sown is pure and due care is exercised, there is very little danger in grazing at any stage of growth unless the crop has suffered a severe check by frost or drought. Sudan Grass readily crosses with other Sorghums, and the plants resulting from the cross seem to take on the poisonous properties of the Sorghums."

6. Prussic acid in Sorghums—S. E. Collison. Bull. 155, University of Florida. Dec, 1919.

"In conclusion it may be said that so far as our knowledge goes at present, there may be some danger in feeding fresh Sorghum or allowing cattle to pasture on fresh Sorghum, if the forage is taken on an empty stomach. To avoid this risk, the material should either be fed after it has been slowly cured or should be given after or in connection with other feeds. Used in this way it is believed that little risk would be incurred in feeding Sorghum grown under normal conditions in Florida."

7. The amount of hydrocyanic acid in Sorghum, Sudan Grass, and some Hybrids—H. Finnemore and C. B. Cox. Royal Society, N.S.W., Sept. 2, 1931.

Conclusions:—All the varieties examined yielded some hydrocyanic acid up to about 130 days after sowing, when the seeding stage had been passed, but the amounts varied considerably. Some gave larger percentages than have hitherto been recorded. Sudan Grass gave the least and Feterita the most.

Owing to slow germination only two of the eight hybrids were available at the time of the first examination, but from the second series of results it seems that these hybrids are lower in hydrocyanic acid, at all events in the first month or two, than the majority of the Sorghums.

The results of other workers have been confirmed in that the percentage of hydrocyanic acid has been found to be greatest in young plants and to diminish as growth proceeds.

. . . it would appear that young Sorghum, even when wilted, cannot always be considered safe as fodder.

8. The Toxicity of Sorghum halepense (Johnson Grass) for sheep—F. H. Manley. *Veterinary Journal*, London, June, 1932.

Conclusion:—"Sorghum halepense, when dried in the early stages of its development, is extremely poisonous for sheep. Insufficient material was available on this occasion to thoroughly determine the toxicity of the fresh young grass. In the later stages of growth the plant appears to be definitely non-toxic."

From the preceding extracts the following conclusions have been drawn:—

Johnson Grass, Sorghum, and Sorghum-Sudan Grass hybrids must all be regarded as potential sources of hydrocyanic acid poisoning until they have reached the flowering stage. The poisonous properties are likely to be most marked if the plants have been stunted by frosts or dry conditions or if grown on soils rich in nitrogen. Wilting does not necessarily destroy the dangerous properties, although it often has that effect. There is some difference of opinion regarding the relative amounts of hydrocyanic acid in Sorghums and hybrids. Climatic conditions evidently play a large part with regard to the quantity of hydrocyanic acid present. The percentage decreases steadily from the time the plant begins growth until it ripens seed, provided the growth has been normal.

Sudan Grass, when free from hybrids, is not likely to be dangerous at any stage of growth, but has the greatest risk where the grass has been stunted by frost or dry conditions. Any risk is minimised by wilting for twenty-four hours prior to feeding. If cattle are to be grazed on Sudan Grass, care should be taken that they are only put on it for a short time at first, particularly if they are hungry. Sudan Grass is as likely to cause hoven or bloat as any other succulent forage.

These conclusions are in conformity with local experience. No authentic case of poisoning due to pure Sudan Grass either during grazing or when used as a cut crop is known, but several fatalities have been traced, with little doubt, to stock eating Sorghum-Sudan Grass hybrids. As these are found usually along with a crop of Sudan Grass, it is natural that persons suffering losses would suspect the Sudan Grass as being the cause of the trouble.

BREEDING FOR 1934.

G. D. SILAW,

Poultry Adviser, Department of Agriculture.

The breeding season is now uppermost in the minds of those engaged in the poultry industry.

Correct mating of the proper birds will go far to ensure a profitable hatching season. The far-seeing breeder has been nursing his breeders through their moulting period by feeding the birds a ration which has brought them through the moult ready to lay eggs of high vitality and hatchability.

Most birds of high egg production must be forced into a moult and this has been done by withholding all egg forcing feeds and feeding only those foods which replace feathers and wasting tissues. Vegetable proteins have been the order and animal proteins withdrawn from the feeds.

The strain on a pullet during her first laying season has been enormous, and it is false economy to allow the high egg producer to keep on laying through the moult, straining her energy and vitality, and then to expect her to produce the egg which gives vitality to the chick. By feeding to stop laying, she has had a chance of a rest and so starts her vital period of chick production well fitted for the work in front of her.

Do not feed breeding pens on a laying-pen mash; rather aim for the hatchable egg than the numbers. The mash should be so constituted as to keep the birds in good condition.

A good breeding ration is—

8 parts green feed,		
4 „ bran	} or	{ 5 parts bran,
4 „ pollard			{ 3 „ wheat meal,
$\frac{1}{2}$ part meat meal,		
$\frac{1}{4}$ „ bone meal,		

with wheat as an evening grain (1 “golden syrup” tin to every 12 birds), followed up by green feed.

Watch the male. He is half the pen. His vitality fertilises all the eggs from the pen, and, should he be run down or starved because of his gallantry, feed him separately. Do not make a practice of changing the males unless the eggs are unfertile. All breeding should be done to a system, and changing males throughout the season causes this system to break down.

Collect the eggs many times daily and store in a cool place. Stack eggs air-cell up at an angle of 45 degrees, and use only clean eggs. Rub off any foreign matter.

If the eggs are to be kept over three days, turn them daily and keep them from draughts, thus retarding evaporation. Operate the incubators to maker's instructions until a grasp is obtained of each machine's peculiarities, when personal knowledge will teach how to hatch out more chicks.

Chicks.

The feeding of chicks is a subject which causes many arguments, but the recommended practice is to feed for body and not eggs until the pullet has completed her first laying season. Even in 1934 one hears boasting that birds came into lay at 4½ to 5 months old, but this indicates the birds have not been fed for body.

Providing one feeds the right food and the chicks keep growing, one should not worry if the pullets are 6½ to 7 months old before they start to lay. Aim for body size and egg capacity and do not tolerate the small bird at all. Keep the chicks moving by withholding animal protein as long as possible and feed the grain heavily. During the first two or three days, give flaked bran, grit and plenty of good water. This should be followed with bran and wheatmeal of equal quantities with cracked wheat at the evening feed. Keep to that ration as a *dry* mash for four weeks, then add 5 per cent. meat meal and 2½ per cent. bone meal (bulk quantities) until the chicks are 12 weeks old. From 12 weeks to 5 months a wet mash can be given in the morning with the dry mash in front of them always.

Green feed should be incorporated in the wet mash, equal quantities in bulk to the other ingredients.

At 5 months feed on the breeder's mash and continue until the pullet has finished her first laying season.

Always feed chaffed up greens after a wheat or cracked wheat feed and have charcoal and shell grit always before the young chicks. It is surprising how much they can consume.

POTATO FERTILISER TRIALS UNDER IRRIGATION AT WAROONA.

E. T. MORGAN,

Officer-in-Charge Potato Branch:

J. C. PALMER, Dip. Agric.,

Potato Inspector.

This is the first occasion on which potato trials under irrigation have been conducted by the Potato Branch of the Department of Agriculture, and is the first of a series to be conducted in irrigation areas.

As much land will be used for the growing of potatoes in the Brunswick-Dardanup area under the Collic irrigation scheme, it is intended to give hints, in this article, of the practice adopted in the Waroona district, where irrigation of potatoes has been carried out with great success for the past 10 years.

FERTILISER TRIAL.

Through the courtesy of Mr. J. Salerian, of Waroona, a portion of new land on his property was made available for the experiments, and we are greatly indebted to him for his care and attention in watering and cultivation. The land selected had previously been timbered with blue gums and large paper barks, and may be described as a sandy loam, well furnished with humus, overlying a somewhat impervious clay at a depth of 18 inches from the surface, which ranged in colour from chocolate to red.

Whole "round" seed of the Delaware variety was used. This was grown on the hills at Young's Siding, harvested in July, and transported to Waroona, where it was immediately raked and allowed to green and sprout.

In planting the area the local practice was followed. The land had been cultivated with a tractor and rotary hoe to a depth of nine or ten inches, and was in excellent condition and thoroughly moist. Each "land" was planted with six rows spaced about 2ft. 6ins. apart with a deep finish which acted as an irrigation ditch between each land.

The tubers were planted after the plough, which was set to plough at a depth of about 9 inches, the potatoes being planted about halfway up the turned furrow, or from 4 to 4½ inches deep. This ensured plenty of loose soil under the tubers, and, in the case of irrigation especially, such practice gives uniformly good results. The experimental plots were planted on the 1st and 2nd of December, which is rather later than the usual planting time of the district, which ranges from October to about the second or third week in November.

Irrigation water was applied on two occasions at 20 day intervals, and a fall of rain of approximately two inches was experienced on March 26, which rendered further irrigation unnecessary.

Germination and growth were excellent, but "Early Blight" made its appearance in the later growing stages and to some extent limited the life of the plants—not allowing of full maturity. Nevertheless good yields were reported, as the figures will show.

Each plot was 1/200th of an acre and was replicated four times. The tables show the average weights obtained from each manurial treatment.

This trial was devised to ascertain whether—

- (a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than no manure;
- (b) A complete manure is better than one of 12 cwt. super. alone;
- (c) the difference between 12 cwt. super. and no manure.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.	Per cent.
1	1	No manure	0 10	5
	2	{ 4cwt. sulphate ammonia 12cwt. super. ... 2cwt. sulphate potash } Control . .	11 3	100
	3	12cwt. super.	7 3	64

This trial was devised to ascertain whether—

- (a) a complete manure, 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia;
- (b) a complete manure is better than one of 2 cwt. sulphate potash;
- (c) the difference between the values of 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.	Per cent.
2	1	4 cwt. sulphate ammonia	1 3	12
	2	{ 4 cwt. sulphate ammonia 12 cwt. super. ... 2 cwt. sulphate potash } Control ..	9 18	100
	3	2 cwt. sulphate potash	0 16	9

This trial was devised to ascertain whether—

- (a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than one of 4 cwt. sulphate ammonia and 12 cwt. super.
- (b) a complete manure is better than one of 12 cwt. super. and 2 cwt. sulphate potash;
- (c) the difference between the values of 4 cwt. sulphate ammonia and 12 cwt. super. and 12 cwt. super. and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.	Per cent.
3	1	{ 4 cwt. sulphate ammonia 12 cwt. super }	11 6	84
	2	{ 4 cwt. sulphate ammonia 12 cwt. super. 2 cwt. sulphate potash } Control ...	13 9	100
	3	{ 12 cwt. super. ... 2 cwt. sulphate potash }	9 13	71

This trial was devised to ascertain whether—

- (a) a complete manure 4 cwt. sulphate ammonia, 12 cwt. super., and 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.
- (b) a complete manure is better than one of 4 cwt. sulphate ammonia, 4 cwt. super., and 2 cwt. sulphate potash.
- (c) the difference between a mixture of 4 cwt. sulphate ammonia, 4 cwt. super., and 2 cwt. sulphate potash and one of 4 cwt. sulphate ammonia and 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.		Per cent.
4	1	{ 4 cwt. sulphate ammonia 2 cwt. sulphate potash }	...	0 12	5
	2	{ 4 cwt. sulphate ammonia 12 cwt. super. 2 cwt. sulphate potash }	Control ...	12 14	100
	3	{ 4 cwt. sulphate ammonia 4 cwt. super. 2 cwt. sulphate potash }	... ..	7 12	60

This trial was devised to ascertain whether—

- (a) a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash is better than 4 cwt. sulphate ammonia, 8 cwt. super., 2 cwt. sulphate potash;
- (b) a complete manure is better than one of 4 cwt. sulphate ammonia, 16 cwt. super., 2 cwt. sulphate potash;
- (c) the difference between mixtures of 4 cwt. sulphate ammonia, 16 cwt. super., 2 cwt. sulphate potash and 4 cwt. sulphate ammonia, 8 cwt. super., 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.		Per cent.
5	1	{ 4 cwt. sulphate ammonia 8 cwt. super. 2 cwt. sulphate potash }	... ..	12 14	118
	2	{ 4 cwt. sulphate ammonia 12 cwt. super. 2 cwt. sulphate potash }	Control ...	10 14	100
	3	{ 4 cwt. sulphate ammonia 16 cwt. super. 2 cwt. sulphate potash }	... ..	12 15	119

This trial was devised to ascertain whether—

- (a) a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash—is better than 2 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash;
- (b) a complete manure is better than one of 6 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash;
- (c) the difference between the mixtures 6 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash and 2 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.		Per cent.
6	1	$\left\{ \begin{array}{l} 2 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 2 \text{ cwt. sulphate potash} \end{array} \right\}$	...	12 14	132
	2	$\left\{ \begin{array}{l} 4 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 2 \text{ cwt. sulphate potash} \end{array} \right\}$	Control ...	9 10	100
	3	$\left\{ \begin{array}{l} 6 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 2 \text{ cwt. sulphate potash} \end{array} \right\}$	... ..	10 14	112

This trial was devised to ascertain whether—

- a complete manure—4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash—is better than 4 cwt. sulphate ammonia, 12 cwt. super., 4 cwt. sulphate potash;
- a complete manure is better than one of 4 cwt. sulphate ammonia, 12 cwt. super., 1 cwt. sulphate potash;
- the difference between mixtures of 4 cwt. sulphate ammonia, 12 cwt. super., 2 cwt. sulphate potash and 4 cwt. sulphate ammonia, 12 cwt. super., 4 cwt. sulphate potash.

Set.	Plot.	Fertiliser.	Calculated Yield per Acre. tons. cwt.		Per cent.
7	1	$\left\{ \begin{array}{l} 4 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 4 \text{ cwt. sulphate potash} \end{array} \right\}$	... ..	12 5	107
	2	$\left\{ \begin{array}{l} 4 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 2 \text{ cwt. sulphate potash} \end{array} \right\}$	Control ...	11 8	100
	3	$\left\{ \begin{array}{l} 4 \text{ cwt. sulphate ammonia} \\ 12 \text{ cwt. super.} \quad \dots \\ 1 \text{ cwt. sulphate potash} \end{array} \right\}$	... ..	12 14	110

Since these trials are the first of a series, which will extend over a period of three years, no conclusive results can be derived from this first trial. The results of this and of the succeeding experiments will be grouped together, and then it is to be hoped that definite information will be obtained for publication.

It was interesting to note how little difference was caused in the results obtained by varying the amounts of sulphate ammonia or sulphate potash.

There seems to be an indication, however, that a very suitable manure for this type of farming and land is a mixture of 2 cwt. sulphate ammonia, 8 cwt. super., and 1-2 cwt. sulphate potash.

General Commentary.

The successful irrigation of the potato crop is a delicate operation. In order to maintain good growth and to ensure that well-shaped tubers are harvested, well directed attention is necessary. It is common to see, in an irrigation-grown potato crop, ill-shaped second growth tubers, making many of them unsaleable. This trouble can be obviated by intelligent watering, but the method adopted must be determined, to a very great extent, by the type of soil being worked. The soil on which the trials were conducted, in common with much of the land in the

Warooka-Hamel area, allows of ready seepage, and furrows 15 to 16 feet apart allow saturation of the subsoil, the moisture rising to the surface by capillary attraction. The land in question holds the moisture well, and about 20 to 24 days between waterings has in practice been found sufficient. Where sandy types of soil are encountered, irrigation by the above method does not appear to be so satisfactory; moisture is not held readily; partial drying out occurs; and growth receives a slight check. On applying water, growth is again stimulated, and ugly, knobby tubers are invariably produced. It would be more satisfactory on this type of soil, to plant sufficiently wide to allow of moulding or ridging and running the water down the furrows made, say every second furrow at the first irrigation, alternating the rows on the second watering, and so on. Water would have to be applied more frequently, at say 10 day intervals. Of course, no hard and fast rule can be laid down as methods adopted must be determined by soil as well as climatic conditions.

The proper grading of the land must receive attention, as low places are generally a source of trouble, flooding easily occurs and much loss is suffered in the hollows as well as on some of the surrounding area. It should always be remembered that water should be applied, so that it runs into the soil underneath the tubers, and this must be done in whatever system of flood irrigation is practised. It is common to see, with new growers, shallow furrows and water everywhere, and much killing of plants in lower lying levels and even on higher places. The tubers are so watery that when dug they soon shrivel and in many cases rot right away.

Even with the potato crop that has been properly irrigated, rot is often observed, and although the tubers may appear sound at the time of digging, much loss occurs in the interim between harvesting and transportation to the markets. This loss can be obviated to a great extent by allowing the land to dry out somewhat before harvesting, which should not be done for at least 10 to 12 days after the last application of water.

Where it is intended to store irrigation grown potatoes over an extended period, they should not be dug until a good fall of rain has been received. It is not possible for the writers to explain the exact action of rain on the crop, but evidently a certain cooling and hardening takes place and practice has demonstrated that potatoes so treated have been kept in ordinary shed storage for 3 months and have been in every way satisfactory after this period.

If it is intended to leave the tubers in the ground, until after a good rain is experienced (which is generally in March or April), the land must be kept sufficiently moist to avoid the possibility of moth infection, which may occur if the land is allowed to become dry.

The effect of irrigation is to consolidate the land, and it is advisable to cultivate between the rows after each application of water, or at least as long as it is possible to run the cultivator between the drills.

The main points to be considered are:—

1. Well-cultivated land prior to planting;
2. The maintenance of an even degree of moisture, avoiding over-watering;
3. The choosing of well-graded land;
4. The necessity of not allowing water to soak into the land level with the tubers;
5. The harvesting of the crop under suitable conditions.

VINE PRUNING.

By H. K. JOHNS, Viticulturist.

(Portion of this article appeared in *Journal of Agriculture*, No. 3, Vol. 10, Sept., 1933.)

"The use of the grape as a food preceded the making of wine. Primitive man, who lived by the chase and on wild fruits, gathered and ate with relish the grapes of the wild vines long before he discovered that he could make a joyous beverage out of them. As time rolled on and life became more settled, he took in the grape vine from the wilderness and gave it cultivation. Then, perhaps, began the selection of the finest and best flavoured grapes, and, presently, the propagation of strains. Left to itself, deprived of man's ceaseless, thoughtful care, the grape vine would revert speedily, helplessly, to the status of its wild progenitor."—(*Extract from "Wine Lands of the World."*)

Therefore, to prune intelligently, many aspects have to be taken into consideration—the age, size, condition of the plant, the location, soil, climate, variety (whether it requires short or long pruning), the principles governing its life, and other features of its environment. Of all fruit-bearing plants, the grape vine is one that requires careful pruning, and like all other fruiting plants, it responds to pruning, and the quality of fruit is improved by it. Pruning has one or more of the following objects:—Modification of shape and habit of the plant, removal, renewal, promotion, or retarding parts of the plant, increase or decrease in size and quantity of the fruit, also training to simplify cultivation, spraying, and the harvesting of the grape crop.

The time for pruning depends on the season's conditions. The only safe rule is that vineyards may be pruned as soon as the vines are dormant. If pruned too soon, the plants will be weakened and new growth will commence early; then, if a frost visitation is recorded, the young growing shoots will be destroyed, with loss of fruitful shoots. Early pruning will cause the vines to start early growth in the spring, while late pruning will considerably delay the shooting of the buds. Generally, in this State, pruning commences in the month of June and is completed by the end of August.

Vine cuttings for propagation may be prepared at any time after vines have become dormant, when cuttings can be selected from the parent plant. They should range from 12 to 18 inches and should always be made from young matured wood and preferably from medium-sized, short jointed wood growths arising from spurs or canes (rods) of previous season's growth. To make cuttings, cut close below the lower bud, the cut to be square across, and leave about an inch of wood above the upper bud or eye.

Each cutting should have the buds removed from the base end upwards, leaving the top two buds intact for production of growth. The reason for elimination of lower buds is to prevent entrance of dry rot, or any other attack such as white ants, which may occur from the decomposing of the buds under ground. Soon after the commencement of the rise of sap and following growth, callousing will heal over all cuts, resulting in the trunk under ground being clean and well barked throughout. Cuttings should be tied in convenient-sized bundles, all buds pointing the same way. The bundles should then be buried in trenches with butt end up and covered with about six inches of soil. Inverting the bundles causes the butts to callous while the tops remain dormant, and the cuttings are ready to

throw out a rooting system soon after planting in nursery or permanent position. If, on the other hand, they are heeled in with buds upwards, they often commence growth prior to developing root growth to support them.

When the ground has become warm enough, or in the early spring—August.—plant the cuttings in well, deeply worked soil. If in nursery, set each cutting at such a depth that only the upper two buds are just above surface level, spacing them about two to four inches apart with about three feet between rows. When selecting land for propagating cuttings, it is advisable, if possible, to have the sets in a position that can be irrigated with at least three or more waterings during the summer months. Also the soil should be kept well stirred with the hoe and cultivator to keep it mellow and as moist as possible. The principle involved is to create a good rooting and head growth the first year prior to planting in permanent position.

A description of the parts of the vine is necessary before the subject of pruning is considered, as per illustrations Nos. 2, 3, 4, and 5.

No. 2.—Photograph of 10-year-old Gordo Blanco Muscatel grown in the Swan Valley, before pruning:—

- (1) Main trunk or body of vine.
- (2) Crown of vine formed at suitable commercial height for trellising.
- (3) Main arms and permanent branches, which are of mature wood of several years old.
- (4) Secondary arms which arise from the main arms and permanent branches.
- (5) Canes of seasonal growth; when young, called "green shorts."
- (6) Laterals which grow from canes in the form of seasonal secondary shoots.
- (7) Water shoots which have sprouted from main trunk of vine.

No. 3.—Photograph of No. 2 after pruning:—

- (1) Main trunk or body of vine.
- (2) Crown.
- (3) Main arms.
- (4) Secondary arms.
- (5) Spurs.



No. 1.

The system adopted in the pruning of this vine, Gordo Blanco Muscatel, is termed spur pruning along the main arm or cordon, spurs being pruned to one clear bud. Generally growers in the Swan Valley shorten back the spurs to the basal bud with the object of lightening the crop and increasing quality. This variety of vine is a prolific bearer.

Illustration No. 2.

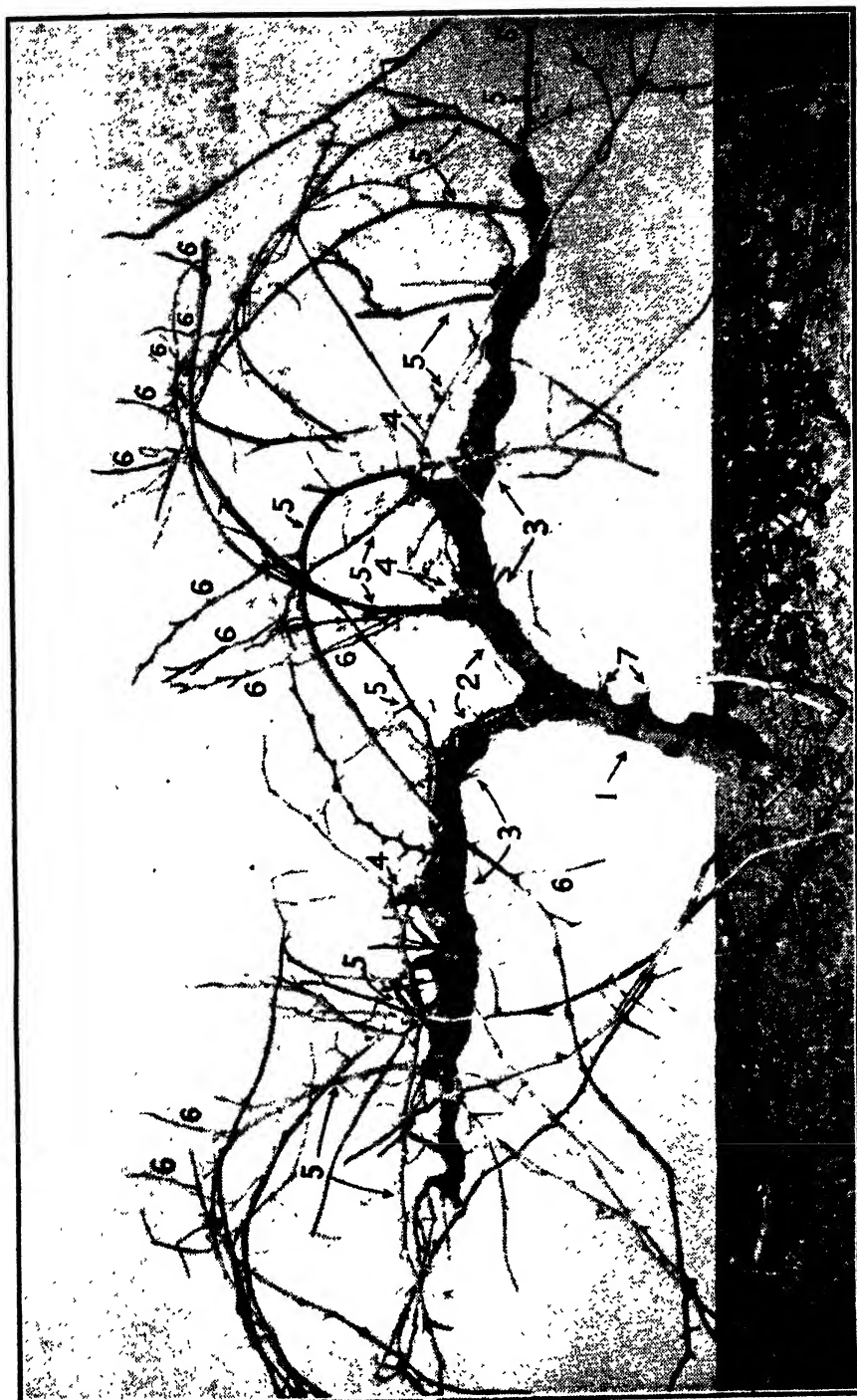


Illustration No. 3.

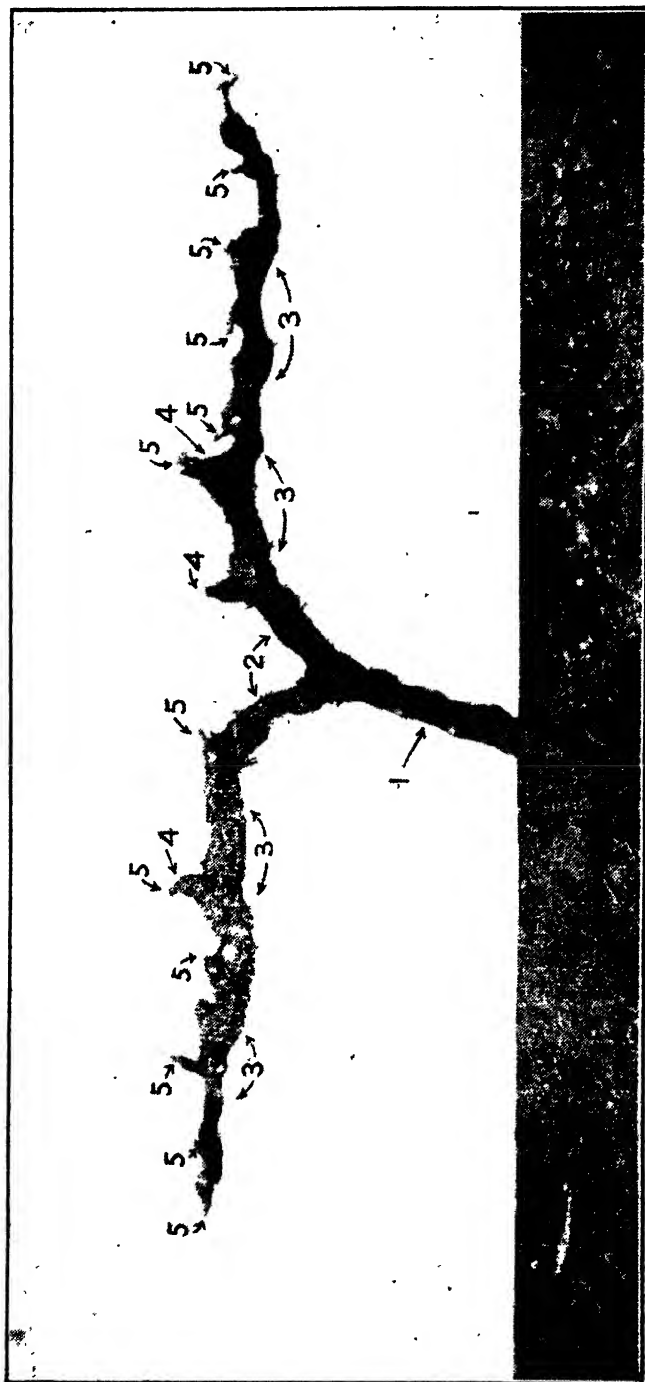
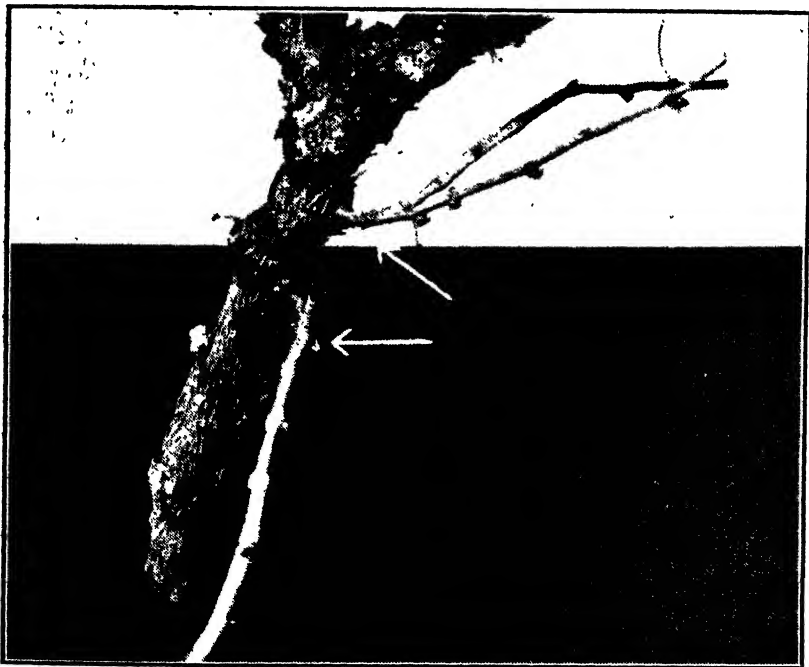


Illustration No. 3A.



No. 3A.—Showing crown, and portion of main arms, with subsidiary arms growing horizontally from main arms which carried the fruiting spurs, and is pruned to two distinct eyes on each fruiting spur. The variety of vine is Zante Currant.

Illustration No. 4.



No. 4.—Shows water shoots growing from main stem or body of vine. These should be pruned closely by the pruner, as shown in illustration No. 3.

Illustration No. 5



No. 5.—Suckers which shoot from under the ground. The earth should be removed and the suckers cleanly removed by the pruner, as they are of no value, and, if allowed to exist, would rob the general growth of the parent stock.

Illustration No. 6

No. 6. This is a sketch of a grape vine after one year's growth in nursery, and the markings indicate the pruning of roots before planting, also pruning of top portion of vine to two distinct buds. Usually no training is given the first year after planting in a permanent position.



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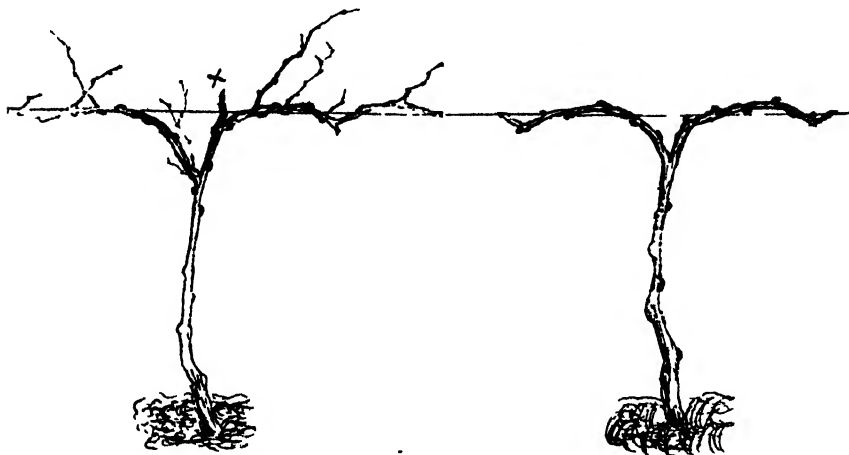
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Illustration No. 7.



No. 7.—A vine pruned after the first year in the vineyard. The most upright growth is selected and pruned to two distinct buds.

Illustrations Nos. 8 and 9.



No. 8.—This shows the growth of the vine following pruning, as in illustration No. 7. Although the vine in No. 7 was pruned to two distinct buds, only one was allowed to grow; all other young shoots have been removed during early growth, preferably when not more than six inches long. This concentrates all the force of growth of the plant into the cane which is to become the main trunk or body of the vine. Care must be taken to stake and tie the growth until it reaches the required height for formation of crown. This care is necessary as a protection against winds, and is also essential for straightness of the main trunk. When the shoot has grown to about nine to ten inches above the height required for formation of crown of vine, the terminal growth should be pinched as marked "X" in illustration (No. 8). This treatment will cause laterals to grow where desired to form main arms for shaping and construction for the following season, as will be noticed in illustration No. 9, showing same vine after pruning.

In covering high structures with trellised vines, it is necessary to train a series of vines of various heights so that the rule of maintaining the fruiting wood upon a common level on each plant may be followed. To secure the length of stem or trunk it sometimes takes a few seasons to grow a shoot of the required height. If the growth from the young vines does not ascend sufficiently far above the required height during the first year, it should at the next pruning season be again pruned back to a spur of a couple of buds to induce a new and vigorous growth, and only one shoot should be allowed to grow from it. This growth should be tied up vertically and when it reaches the required height, its terminal growth should be pinched off.

As the main stem or trunk supports the framework of the vine, raised to the desired height above the ground, the next consideration is to determine what height the length of trunk should be. This varies according to requirements and is governed by certain factors—in the field with vines trained under the Goblet, or otherwise known as the Gooseberry-bush system, a useful height is from 10 inches to 18 inches, which is desirable before crown formation. Vines with short trunk and low crown formation are liable to damage from frosts, also the grapes are likely to become damaged from cultivators and dust. The extra height will also be an advantage when pruning and disbudding the vines, and picking the fruit.

With vines to be trained and grown on trellises in the field, the trunk length varies according to variety of grape: generally, the trunk is from 2 feet in length.

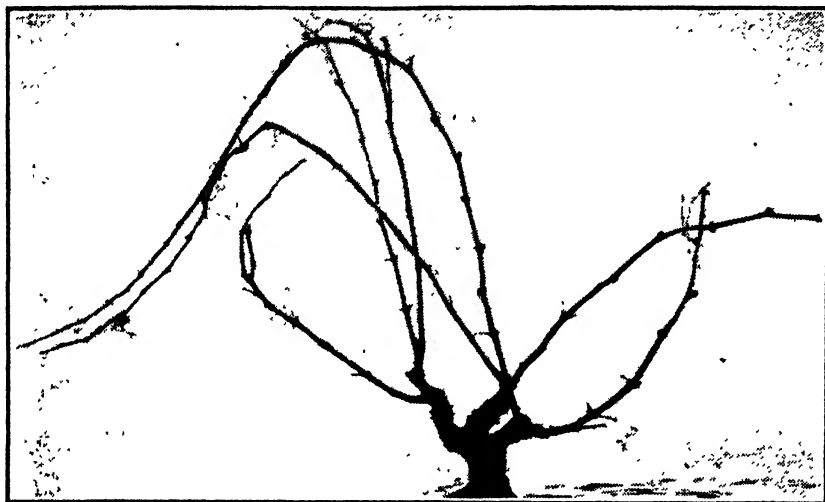
Root Treatment.—A number of roots grow on many vine horizontals from the main trunk of vine just under the surface, while others grow deeper and of a straight downward growth. Those roots which stay near the surface of the soil will sooner or later suffer during a long spell of hot weather, as the vine during that period has a very heavy task to perform, that is, to propagate growth in foliage and wood, also mature and ripen the fruit. Therefore it is necessary that during the second and third year all young planted vines should have the plant dug round to a depth of not less than six inches and all roots which have developed from the main trunk of vine to depth mentioned should be cut off close to the main stem. This will help to stabilise and develop the lower rooting system, and facilitate deep cultivation, which is necessary for the first ploughing during the winter months, without injury to the vine. It is essential that young vines should be properly cared for during their period of training and formation, as the early years of growth and treatment given the vines during that term largely determine the profit and good working to be derived from them.

There are two distinct methods of pruning—spur and rod pruning—and the two methods are applied individually or in combination, according to the habit of the growth of the vine. A rule that is to be remembered is that all vines bear fruit on the new wood, but, with most varieties, bearing wood only grows from wood of the previous year's growth. Vigorous growths sometimes grow from the old wood or main arms of the vine, and are called "water shoots," and do not produce grapes in the first season, so it is a safe rule for an amateur pruner to cut water shoots away. They should only be left in case of improving the shape of the vine. Some vines produce the fruit-bearing buds at the base of their canes, whilst in the vigorous growing varieties their fruit-bearing buds are situated well along the canes; therefore we find it necessary to spur prune and rod prune.

In pruning, selected fruit-bearing canes are cut back to spurs and rods. A spur is cut back generally to two clear buds, but the number of spurs to be left on each vine is to the judgment of the pruner, as he has to consider the variety and vigour of the plant. Spurs should be from four inches to eight inches apart, the strongest and most matured canes to be used, and on no account leave a cluster of spurs. In leaving too many spurs, the vines may bear too many and too small grapes. To find the medium between these extremes is always a great object and study to which the grower should devote his attention. If more than two eyes are left, the lower eyes may not develop, and the only thing attained by such pruning is to increase the size of the head and length of secondary arms, and thus place the leaves and grapes farther away from the main centre of the vine; also the vine and grapes will suffer damage from the implements during cultivation. In pruning the spurs, the cut should be made about midway along the internode, or well above the second bud, and not so close to it that it will be injured and dry out. A rod is actually a fruit-bearing cane cut back, leaving six buds upwards to one dozen to be suppressed the following year and a replacement to be laid down where vines

grow strong and vigorous, and the variety is one that produces its fruit-bearing buds well along the canes. More wood is to be left, but there is a danger or at least a disadvantage in pruning either too short or too long, and in leaving too many spurs or rods. On leaving too many eyes, the shape of the vine is changed and becomes elongated, or even seriously injured. Definite direction of pruning cannot be applied to every locality or to every vine, as soils, variety, and climate are not all alike; therefore the methods of pruning have to be modified.

Illustration No 10.



No. 10.—Vine before pruning, trained under the Goblet, or otherwise known as the Gooseberry-bush system. It is the simplest and cheapest method of pruning and training vines, and is in vogue in most commercial wine-growing vineyards,

Illustration No. 11.



and the method also facilitates cultivation. An ordinary vine at about five years old consists of a trunk from which spring four or five arms; arising from them are the spurs from which the canes grow and carry the fruit.

No. 11.—The same vine pruned to the Basket-handle system, which embodies the spur and rod pruning in combination. The rods are interwoven; the principle involved is the rods to carry the fruit for the ensuing season, and at the next pruning season they are suppressed by the pruner and replaced by canes or rods growth arising from the spurs.

Illustration No. 12.



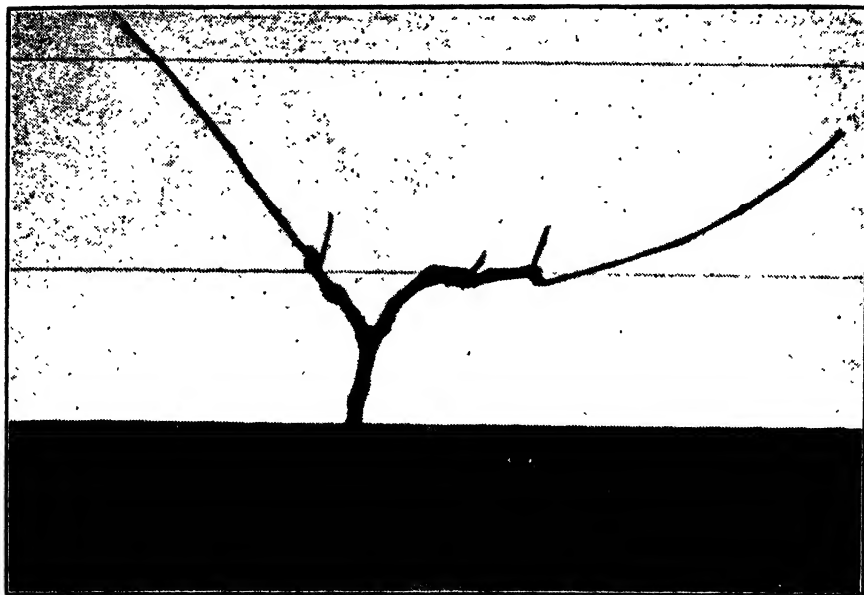
No. 12.—Vine pruned to the Goblet or Gooseberry bush system. The spurs of last season are cut off just outside the inner canes, which in turn are 'cut back' to spurs, carrying two distinct eyes or buds. The pruning each winter is to create a promotion of a regular system of spur renewal. As the vine becomes older and more vigorous, it will stand more cropping, and then more spurs are left to increase the yielding capacity of the vine. The head of the vine should be kept well balanced in shape, and as time elapses the arms of the respective spurs are renewed, and new arms and spurs are grown.

Illustration No. 13.



No. 13.—Shiraz vine before pruning.

Illustration No. 14.



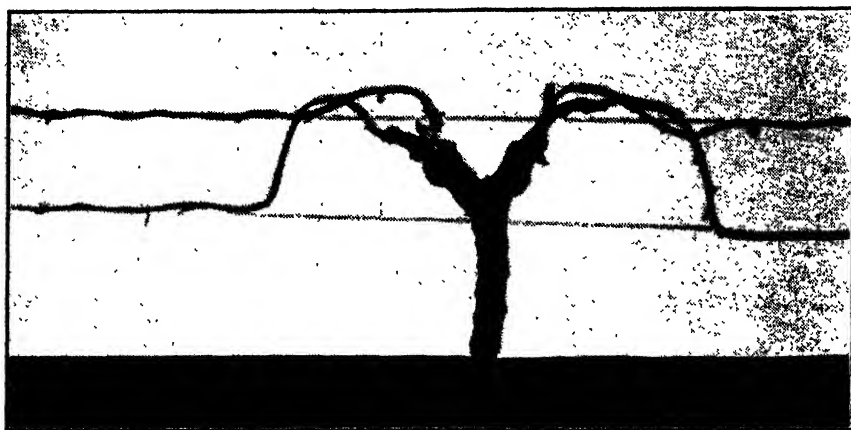
No. 14. -Shiraz vine after pruning to the Bordelais Espalier or Double Guyot system. This method is quite simple and is most suitable for varieties that require rod and spur. The annual pruning consists of removing the previous year's rods and all water shoots, and utilising the two canes from last year's spur for a rod and spur. After pruning, the rods are tied securely at the ends to the bottom trellis wire.

Illustration No. 15.



No. 15.—Sultanta vine before pruning: this variety crops heavily with long rod pruning.

Illustration No. 16.



No. 16.—Sultana vine after pruning to four long rods and also spurs pruned to two distinct buds. The rods are rolled round the trellis wire and tied at the extreme end. The number of rods to be left on the vine is a question of judgment by the pruner; the vigour of the vine, soil and climatic conditions have all to be taken into consideration.

Dr. Hogg describes this grape under the name sultana. It is a native of Anatolia and was brought from Smyrna to Greece, where it has done remarkably well, and has subsequently spread to all viticultural countries. The sultana is a very vigorous grower and produces well in dry climates under irrigation.

The methods now applied to the cultivation of the sultana vine which have been gained by very long experience, have taught man how to prune and train the vines in order to obtain the desired result. Generally this variety requires long rod pruning, and a number of spurs should be left with the object of controlling the shape as well as producing canes and rods for future cropping. As the first four or five buds on the pruned rod will give very little fruit, to assist the increase in crop it is necessary to control the vine during the growing period, and this is directed towards the production of a rod carrying more fertile buds. The sultana vine when well grown has a tendency to abnormal length of growth, and if unchecked, the fruit buds are often found well out from the main stem of the vine. In order to check any waste energy a system of tipping the terminal of the shoots required for next season's pruning wood should be carried out.

Summer pruning or topping is a much disputed operation which, however, at least in some cases is of great importance. The principal object is to force a way injures the vine: the sap is checked in its flow for a few days only, and within the ordinary pruning radius along the selected pruning rod. This checking in no way injures the vine: the sap is checked in its flow for a few days only, and within a week the new side shoots (laterals) make their appearance. The prevention of elongation should be carried out when the required rod or cane is between 2 to 4 feet in length, according to the vigour of the vine. Drastic and deep cutting and removing of green functioning leaves means injury to the plant. Always bear in mind the principle involved is tipping of the terminal end of the canes, and, therefore, check any tendency of waste energy.

The following varieties should be spur pruned to produce and keep up the quality of the fruit—all muscatel varieties, viz., Gordo Blanco, Frontignac, Red

Muscatel, Muscat Hamburg, Muscat Alexandria, Madresfield Court, Black Muscat, Cannon Hall Muscat, Royal Muscadine, Wortley Hall, Red and Black Malaga, Santa Paula, Gros Colman, Sweet Water, Grand Turk, Trebbiano, Valencia, Dora-dillo, Chasselas, Black Hamburg, Red Prince, Red May, Aramon, Grenache, Reising, Matara, Malbec, Burgundy, Pedro Ximenes, Blue Imperial, Zante Currants, Early Madeline.

The following varieties respond well to rod and spur pruning—Shiraz, Malbec, Carbernet, Pinot, Sultana, Black Prince, Ohanez (Almeria), Waltham Cross, Lady's Finger, Flame Tokay, Knight's Centennial, Black St. Peter, Grand Turk, and Purple Cornichon.

In this article only the general principles of pruning are set out, as it is impossible to enter into details, success in pruning only being gained by practical experience.

SMALL FARM WOOL-PRESS.

H. MCCALLUM,

Sheep and Wool Inspector, Department of Agriculture.

Set out below are specifications for the construction of a small farm wool-press which will be of interest to farmers whose flocks are not sufficiently large to warrant the purchase of an expensive press:—

Material required:—

Two sides, each 4ft. 6in. x 2ft. 5in.

Two sides, each 4ft. 6in. x 2ft. 3in.

(suggest 6in. x 1in. hardwood).

Eight chocks, each 2ft. 11in. x 3in. x 2in. hardwood.

12 staples—No. 8 fencing wire

4 skewers—No. 6 fencing wire

(sharpened at one end).

Construction.—The sides are placed in position and the chocks bolted where they cross at the corners. For the staples small holes are bored 2 inches from the top and the wire driven through and turned up inside. This forms a container with sides 2 ft. 3in. square (inside measurements) by 4ft. 6in. high and will turn out neat bales of between 2cwt. and 3 cwt.

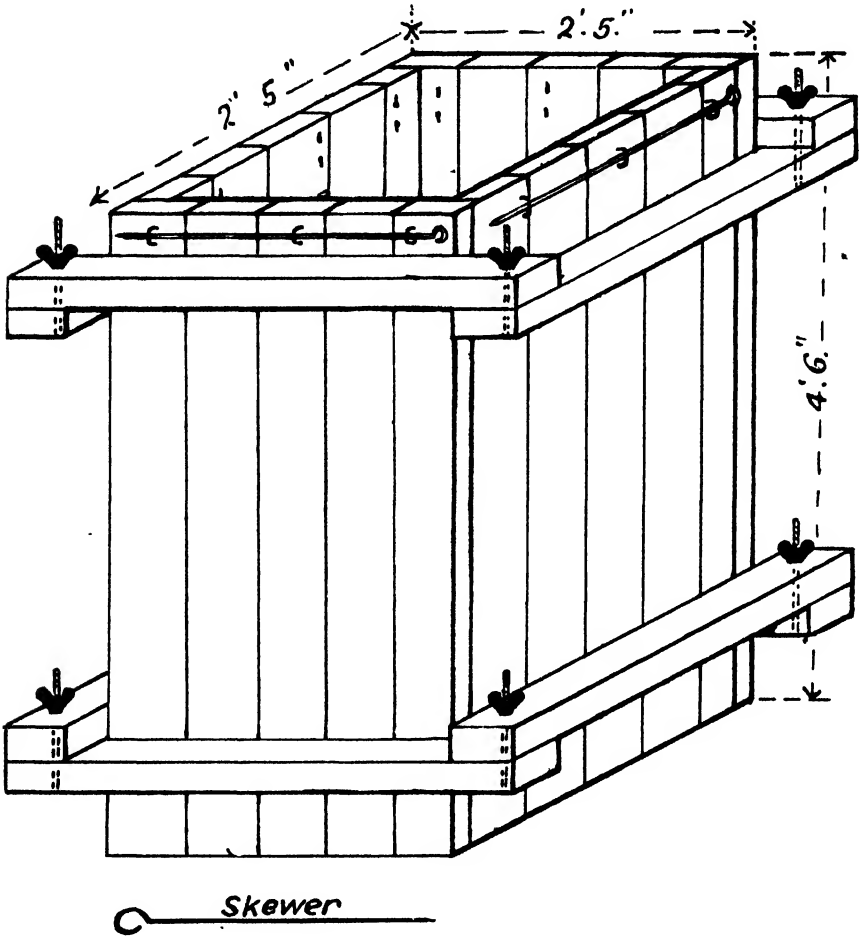
Packing.—The wool-pack (4ft. 6in. x 2ft. 3in. square) is put into the wooden frame, with the corners about 4 inches from the floor and the centre bottom of the pack touching the floor, and is held by running the skewers through the pack, then the staple, then the pack and so on, so that no cutting of the pack is necessary.

The wool must be well pressed or tramped in carefully, filling in the corners first. If this is not done it will be impossible to obtain a square and neatly finished bale.

When the packing is completed, the skewers are withdrawn, the cap is pulled over (the slack being neatly tucked under) and drawn tightly with the centre four-ply stitch.

Two bolts can then be knocked out and the bale released and neatly sewn up or fastened with bale fasteners.

When the pressing and baling is completed it is advisable to immediately brand the packs so that no mistakes will be made in describing the contents.



THE CULTIVATION OF THE PASSION FRUIT.

G. B. BARNETT,

Tropical Adviser, Dept. of Agriculture.

The possibilities of the profitable cultivation of Passion Fruit in Western Australia, and particularly in the Northern portions, are very encouraging, providing methodical cultural practices are adopted. Owing to the geographical position of the Northern districts and the comparatively mild winter, passion fruit should be ready for harvesting in November and December—a time when the metropolitan markets are bare of this fruit, as when grown in the Southern areas the passion fruit does not mature until Christmas time or early in the new year.

SELECTION OF SOIL.

The passion vine thrives best on a well-drained, rich, sandy loam, but it can be grown on a wide range of soils with the aid of manures and providing the soil is not liable to become waterlogged. Protection from frosts and boisterous winds should always be provided.

PREPARATION OF THE SOIL.

It is of very great importance that the land should be thoroughly prepared prior to planting. As far as possible, all roots of the original native trees should be removed so as to minimise the attack of white ants. The soil should be ploughed and the surface reduced to a good tilth. If the soil is sour or so heavy that tillage is difficult, an application of lime, say half a ton to one ton per acre, will prove of advantage if applied after the first ploughing.

RAISING YOUNG PLANTS.

As most districts in Western Australia appear to be quite free of the major passion vine diseases and pests, it is essential that every precaution should be taken to prevent their introduction. With this object in view, growers are strongly advised to refrain from introducing seed, and particularly plants, of doubtful origin. It is advantageous, therefore, for the prospective grower to raise his own seedlings in preference to purchasing them. He then has a wider selection in order to secure the more robust plants, and to thus develop an even and vigorous block of vines. It is frequently stated that this practice has had poor results, but, provided the methods recommended are adopted, little difficulty should be experienced in obtaining a good germination and robust plants.

Seed from fruit of good size and quality (i.e., fruit with hard shell and possessing fullness of pulp) and from vines which are known to be heavy croppers should be selected. Selection should not be on the basis of large size only, for frequently the large fruit are found to possess sparseness of pulp and to have been produced from light bearing vines. To raise young vines from such seed is to incur the risk of having vines which produce light crops and fruit of low pulp quality.

The fruit, after selection, may be allowed to dry out or shrivel and the shell can then be crushed in the hand and the seed extracted. If it is desired to hold the seed for any length of time, the fresh pulp should be removed from the ripe fruit, spread out and allowed to dry. Some growers prefer to wash the seed in water prior to drying, but by so doing it is probable that the thin film surrounding the seeds may be removed and the germinating quality reduced. After

drying, the seed should be stored in bottles or tins in a dry cool place, and if likely to be kept for any length of time should be fumigated with carbon bisulphide.

The seed should be planted in well drained, free working, and fertile soil in beds or boxes protected from the severe rays of the sun by hessian or other screens, in rows about eight to twelve inches apart and about half an inch deep in the soil. The seed should be pressed firmly into the soil, and, after being covered loosely with soil, a light coating of old manure may be sprinkled over the surface to act as a mulch. After planting, the bed should receive a thorough but not excessive watering and the soil kept continually moist. The seed should commence to germinate about the fourth or fifth week and, as the seedlings develop, thinning out should take place, allowing one plant to about every four to six inches. Retain only the best sturdy dark green plants. Pale green ones and "runts" cannot be expected to develop into highly productive vines.

PLANTING OUT.

The plants are ready to be removed to their permanent positions when eight inches high. If, for any reason, planting out is delayed and vines obtain several feet of growth, it is advisable to cut the vines back to within about eight inches of the ground prior to removal from the seed bed. Every care should be taken to avoid disturbing the tender roots or soil at time of removal, and as much soil as possible should accompany the seedling. This can be greatly aided by giving the seedlings a thorough watering a few hours before removal. Transplanting should be done as far as possible during the cooler part of the day, i.e., in the afternoon.

TIME OF PLANTING.

Although the passion vine can be planted at practically any time of the year, it is recommended that early spring or autumn planting be adopted; the former for preference. By planting seed in the late summer, the resulting seedlings should be in suitable condition for planting out in early spring.

LAYING OUT THE LAND.

Prior to planting out the vines, the land should be laid out to enable them to be planted in rows eight feet apart with the vines spaced at intervals of 15 to 18 feet in the row. Where possible, the rows should run in a northerly and southerly direction so that as much sunlight as possible will penetrate the vines. Where irrigation is to be practised, water furrows or basins should be made along the proposed row of vines. Suitable holes should be dug for the vines and filled in, taking care that the surface soil is replaced in the last eight inches of top soil. Avoid placing any fresh organic manures in the holes, but well-rotted manure or leaf mould will be of benefit to the young vines.

ERECTION OF SUITABLE TRELLIS.

Many and varied are the methods adopted for training the vines. All of these have advantages and possible disadvantages, but it is likely the most popular in the Eastern States will prove quite suitable for Western Australian conditions.

The trellis should be erected along the proposed row of vines and should consist of good solid posts placed about every 15 to 18 feet apart. They should be eight feet long and about eight inches thick and placed two feet in the ground. The end posts of each trellis should be extra heavy and securely strutted, for,

when the vines are bearing, an enormous strain is placed on these end posts. Two No. 8 or No. 10 wires are attached about three inches from the top of the

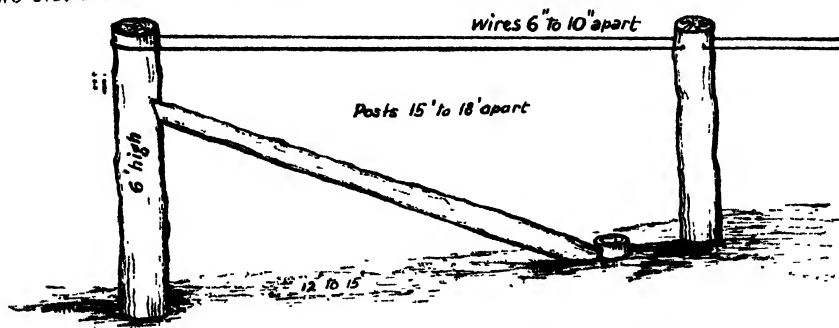


Fig 1

end posts, one on each side, so that when in position the two wires should be parallel and eight inches apart (see Fig. 1). The two wires should be strained tight and attached to each post in the row either by staples or laced to the posts

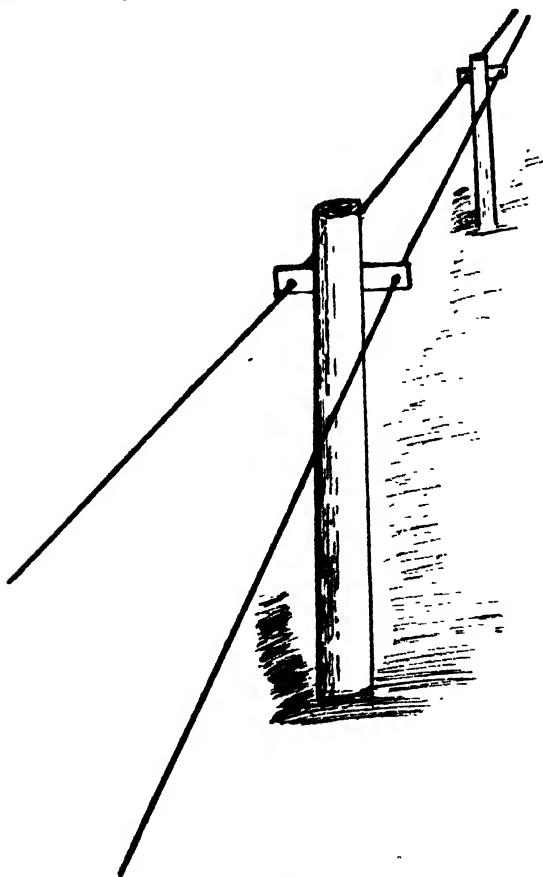


Fig. 2.

with tie wire. Where posts sufficiently wire are obtainable, the wires may be run through holes bored eight inches apart in the posts. If posts less than eight inches wide only are available, 10-inch battens may be attached firmly to the tops of the posts and the wires run through holes in them (see Fig. 2).

TRAINING THE YOUNG VINE.

As previously mentioned, the plants should be placed in their permanent positions during the cool afternoon and should be immediately watered but without submerging the foliage.

Under irrigation conditions, rational irrigation should be adopted until the vines are well established. The number of times the vines will need irrigating will depend greatly on the size of holes, furrows or basins, soil and weather conditions, but providing the soil has good drainage, the risk of over-watering is not likely to be great.

The vines should be placed midway between the posts, right under the wires, and a light stake provided beside the young vine and attached to the two parallel wires. The vine should be trained up the stake by tying the main growth to it as six or eight inches of growth is made. All side shoots should be pinched out as they appear, until the vine has reached the wire, when the terminal growth should be nipped off and the last four side shoots allowed to develop (Fig. 3).



Fig. 3.

A young vine trained on to the parallel wire or horizontal trellis.

These in turn should be trained along the wires, two to the left and two to the right. When removing the side growth from the main stem avoid removing leaves which are attached to the main stem, as these leaves assist greatly in shading the young stem. When the laterals which have been trained along the wires reach the similar growth on the adjacent vine, the terminal growth should be cut off. By doing this, the lateral growth will develop more readily, and it is upon this growth that the major portion of the crop will be carried.

PRUNING.

There is no definite system to follow in the pruning of the passion vine. Suffice it to say that after the summer crop has been harvested, the vines should receive a reasonable amount of attention in that the old bearing fruit wood or laterals should be cut back to suitable sublateral shoots. It is inadvisable to cut back to a dormant eye, for seldom will such a bud burst and form suitable fruiting wood. When too many laterals have developed, they may be thinned out and some of those remaining, shortened back to suitable sublateral growths to within 12 or 15 inches of the wires. No lateral growth should be left close to the ground, as the succeeding growth will trail on the ground, and fruit borne on this growth will be blemished and rendered unsuitable for market.

MANURING.

At planting time two satisfactory methods of manuring may be adopted. The first is to apply superphosphate at the rate of half a pound per vine, well mixed with the soil, so that none of the fertiliser can come in direct contact with the roots. Three to four weeks after planting, the vine should be top-dressed with two ounces of sulphate of ammonia, and this top-dressing may be repeated as required should the vine fail to continue making vigorous growth.

The second method is to apply a mixture of superphosphate and blood and bone in equal parts at the rate of half a pound of each per vine. When this plan is adopted the nitrogen supplied by the sulphate of ammonia in the first method is supplied by the blood and bone, and hence there is no need for top-dressing within the first month as recommended in that plan.

It is necessary to emphasise that the fertilisers in both cases must be thoroughly mixed with the soil so that they do not come in direct contact with the roots when the vine is planted.

As a basic part of any subsequent manuring practice, it is strongly recommended that, in accordance with general orchard practice, some kind of cover crop such as cow peas, vetches, Jerusalem pea, etc., be planted in the most suitable season according to the locality in which the crop is grown. The seed of the cover crop should be planted in drills, and the resulting crop turned under when in full bloom, and then as it rots, the humus destroyed by cultivation will be replaced and also the nitrogen removed by the fruit and vines.

To ensure a maximum growth of the cover crops, it will be necessary in most soils in Western Australia to apply 2 cwt. of superphosphate per acre. With this should be added 2 cwt. of muriate of potash in order to replace the potash removed by the fruit. This is equivalent to eight ounces each of superphosphate and muriate of potash per vine, but it is best applied broadcast so that the cover crop can obtain full benefit from it. As some commercial fertilisers have an injurious effect on the vitality of seeds, they should not be applied directly with the seed of the cover crop.

Most of the nitrogen required by the passion vines will be provided by the decaying cover crop, but the amount available during decomposition may not be sufficient to meet the demands of the quickly growing fruit, and therefore a top-dressing of sulphate of ammonia at the rate of half a pound per vine should be broadcast both in the spring and in the autumn. Sulphate of ammonia is recommended on account of its comparative cheapness, but blood, 13 ounces, blood and bone, 30 ounces, or nitrate of soda, 11 ounces, can be used instead of this provided their respective prices are favourable.

The manurial programme recommended is based upon the requirements of the bearing passion vine, which were estimated by Guthrie* to be—

Nitrogen	..	..	..	..	..	6½ ozs.
Phosphoric acid	..	..	..	..	..	1½ ozs.
Potash	..	..	..	..	..	4 ozs.

The amount of superphosphate recommended is in excess of the estimated needs of the bearing plant, but this is because of the special requirements of Western Australian soils for phosphoric acid and, in consequence, the need for liberal applications of superphosphate in order to remedy this deficiency, and in order to stimulate the growth of the cover crops so as to produce maximum yields.

The quantity of fertiliser will require to be increased if very heavy crops are produced, and on soils relatively low in fertility the fertiliser recommended for application at planting time will require to be increased and probably supplemented by the addition of a potash fertiliser in order to remedy natural deficiencies in the soil.

It is impossible to exaggerate the importance of growing these cover crops. Not only do these crops collect nitrogen from the air for the use of the passion-vine, but they also maintain the supply of organic matter in the soil. Unless this be done its physical character will deteriorate and the maximum response to commercial fertilisers will not be achieved.

CROPPING.

The vines should carry a light crop about eight months after planting, and full bearing should be reached in approximately 18 months from planting.

Two main crops a year can usually be expected, namely summer and winter. The former should prove the most profitable crop for Northern growers in that they should be able to mature their crop in November and December, catching the previously mentioned empty Perth market.

The less handling of the fruit at harvesting time the better, as the fruit is very easily blemished. It should be picked from the vine when coloured and packed for market with the fruit stalk attached, otherwise the keeping quality of the fruit will be poor. Honest grading to size and careful packing will repay the grower.

DISEASES.

As already mentioned, the Northern district is apparently free from disease, but perhaps a few notes on the major diseases affecting the vine in other countries, may assist the grower to detect disease if such should develop.

Brown Spot fungus attacks the leaves, stem, and fruit. The first indication of infection on the leaves is the formation of small brown spots which later may develop a lighter-coloured central area, and expand to a circular blotch of one inch in diameter. On the stem, dark brown elongated spots appear which may extend right round the stem, obstructing the sap flow and causing the foliage to wither and die. Dark green, water-soaked blotches appear on the fruit, and as they enlarge they become brownish in the centre, which causes a sinking of the affected area. Eventually the fruit shrivels and falls (Figs. 4 and 5). This disease is most apparent during humid summer weather conditions. The disease can be controlled by spraying the vines with Bordeaux Mixture 6:4:50 at monthly or two-monthly intervals as required, combined with judicious pruning to allow adequate light and air circulation through the vine.

* "Manures for Passion Vines"—Agric. Gaz., N.S.W., Vol. XV., March, 1908.



Fig. 4.
Vine sprayed with Bordeaux Mixture to prevent Brown Spot infection



Fig. 5.
Vine in next trellis to vine depicted in Fig. 4. Note defoliation and dropping of fruit caused by Brown Spot infection.

Bullet or Woodiness (a virus disease) can only be controlled by the destruction of infected vines. Symptoms of the disease are that the skin of the fruit becomes abnormally hard and thick, the skin at times cracks, and the fruit contains only a small amount of pulp. The vine itself shows a stunted and deteriorated appearance, and the foliage is curled and twisted. This latter symptom is very apparent in the terminal growth.

OAT VARIETY TRIALS.

H. G. ELLIOTT,

Agricultural Adviser, Dairy Branch.

Oat variety trials have been conducted in the South-West for a number of years by officers of the Dairy Branch and were continued during 1933.

At Denmark the experiments were conducted on the Denmark Experiment Farm.

Soil: Gravelly loam.

Cultivation: Land fallowed, cultivated, harrowed, and sown at end of May.

Rate of Seeding: 2 bushels per acre.

Fertiliser: $1\frac{1}{2}$ cwts. superphosphate per acre.

The yields were as follow:—

Variety.	Yield.				Percentage Yield Hay.
	tons	cwt.	qrs.	lb.	
Algerian Oats	2	3	2	2	100
Guyra Oats	1	17	0	24	85
Burt's Early Oats	1	11	3	7	71
Mulga Oats	1	10	2	12	70
*Yandilla King Wheat	1	15	0	12	80

*This variety of Wheat was included in the trials this year.

Experiments conducted on the property of Mr. Barton Langridge, Donnybrook:—

Rate of seeding: 2 bushels per acre.

Fertiliser: $1\frac{1}{2}$ cwts. per acre.

The yields were as follow:—

Variety.	Yield.				Percentage Yield Hay.
	tons	cwt.	qrs.	lb.	
Algerian Oats	1	10	0	0	100
Guyra Oats	1	5	0	0	83
Burt's Early Oats	1	15	0	0	117
Mulga Oats	2	5	0	0	150

The average of the 28 trials conducted throughout the South-West are shown in the following table:-

Variety.	Yield.				Percentage Yield Hay.
	Average 74 Plots = 28 Trials.				
	tons	cwt.	qrs.	lb.	
Algerian Oats	2	8	1	11	100
Guyra Oats	2	3	2	22	90
*Lachlan Oats	2	2	0	7	87
Burt's Early Oats	1	15	2	17	74
Mulga Oats	1	15	1	25	73

* Lachlan - 20 plots only.

COUCH GRASS MITE.

Eriophyes tenuis ? (*Nelepa*).

L. J. NEWMAN, F.R.E.S., Government Entomologist.

During the past few years it has become increasingly difficult to maintain a consistently healthy growth of couch grass in many bowling greens, tennis courts and home lawns. Patches have appeared in the lawns, which refused to respond to manual treatment. The grass failed to make runners, growing only in tufts, and also assumed a sickly appearance. This proved not only disappointing and unsightly, but in the case of lawns used for tennis, bowls, or other games, it seriously affected the playing surface. Many inquiries have been received as to the cause of the trouble, and considerable research has been undertaken by the Pathologist, Agrostologist, and Entomologist.

It was thought that the trouble might be due to under manuring, the use of wrong fertilisers, excess wear by constant playing of games, or the need of a complete reconditioning of the lawns. It appears that soil fungi have been responsible for a certain amount of grass injury in some cases.

Recently in the continuance of efforts to arrive at the causative factor, a microscopic mite was discovered. It is definitely believed that this mite is responsible for much of the patchiness and poverty of growth sometimes found in couch grass lawns. The mite has been recorded from widely separated places, namely, Geraldton, Northam, and the metropolitan area, and no doubt can be found in many other parts of the State.

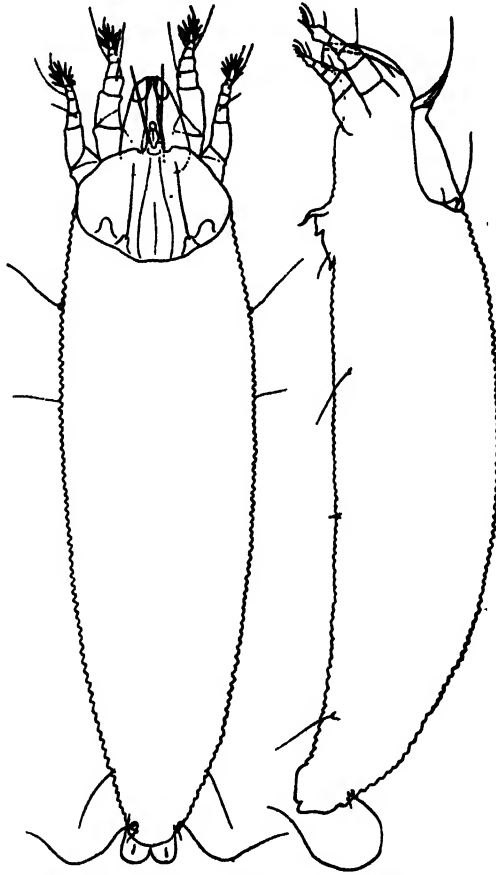
Mites are not true insects, but belong to the invertebrate animals, known as the Arthropoda and to the order *Acarina*. They are related to spiders and ticks. Though not true insects, they are often serious pests in the garden, and in some instances are a serious annoyance to animals and humans.

They are distinguished from insects in the numbers and structure of their legs; while insects only have six legs and are known as hexapods, mites, according to their species, may possess four, six, or eight legs. In the species here referred to as the Couch Grass Mite, there are only four legs, situated near the head.

This mite belongs to the family of mites known as the *Eriophyidae* and to the genus *Eriophyes*. Its specific name is probably *Eriophyes tenuis*. It is known to

exist in European countries, where it attacks several species of grasses. The members of this family are all so minute that they can only be studied with the aid of a high power microscope; they cannot be discerned with the naked eye. The *Eriophyidae* are amongst the most curious of the *Acarina*. They make up for their lack of size by their great numbers and are strictly plant feeders, many species causing galls (such as our common Pear Leaf "Blister" Mite), fuzzy spots or other deformations on plants.

The mite under discussion is one one-hundred-and-fiftieth of an inch long, is of a greyish white colour and semi opaque. As before stated there are but four legs, situated near the head. At the tip of the abdomen is an anal sucker, which



Figs. 1 and 2. Greatly enlarged. After Tucker
 Pear Leaf Blister Mite, *Eriophyes pyri*. Back and side view.
 The Couch Grass Mite is closely related and in general appearance is very similar.

aids the mite in holding on to a surface but does not assist in locomotion. The mite appears to be able to move rapidly over the plant surface. The abdominal segment of the body has a number of rings or annulations, giving the impression of corrugation, and there are a few hairs scattered in pairs here and there. (Figures 1 and 2.) The eggs are circular transparent bodies, laid separately in sheltered positions upon the surface of the leaf. They are quite large as compared with the mite which lays them.

In examining the infested grass, the mites were found in large numbers attacking the buds within the axils of the leaves, resulting in a bunching of the leafy shoots, so that the plants instead of making runners and spreading in the normal way, produce a proliferation or several buds from the affected points, imparting to the whole a bunching or tufting effect, a growth which is characteristic of injury caused by the mite. (Figure 3.)



Couch Grass, showing typical proliferation and bunchy growth produced by mite attack.
Note the lack of lateral runners.

In samples which appear to be more seriously affected, something akin to a fasciation is produced, so that more or less flattened or abbreviated stems are formed producing opposite rows of scale-like leaves, somewhat resembling small heads of barley.

Any such appearance in a couch lawn should be suspected of being caused by this mite.

Treatment Recommended.—Select a fine period of bright weather and closely mow the lawn. (See that all the grass so removed is destroyed by fire.) Follow the cutting with a thorough spraying with one of the proprietary lime and sulphur washes, using at a strength of 1 part to 60 parts of water. Apply with coarse nozzle, making sure that the spray is forced well down into the grass. It will serve little purpose if merely applied as a fine atomised mist to the surface of the grass.

As numerous eggs are always present and these are not readily destroyed by the spraying, a second application of the spray to the infested portions of the lawn should be made three weeks later, after being mowed.

The grass, after treatment, should be stimulated to growth by dressing with suitable lawn fertiliser such as sulphate of ammonia, nitrate of soda, or special lawn manures.

No doubt this mite, like other closely related species, would succumb to any contact spray or dust, the secret of success being in the bringing of the spray or dust into contact with the mite. To do this necessitates thoroughness of application.

Wherever tufty or infested grass can be pulled up, this should be carefully done and destroyed by fire.

For the naming of the mite, I am indebted to Mr. H. Womersley, Entomologist, South Australia.

AGRICULTURAL PROBLEMS.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district or the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

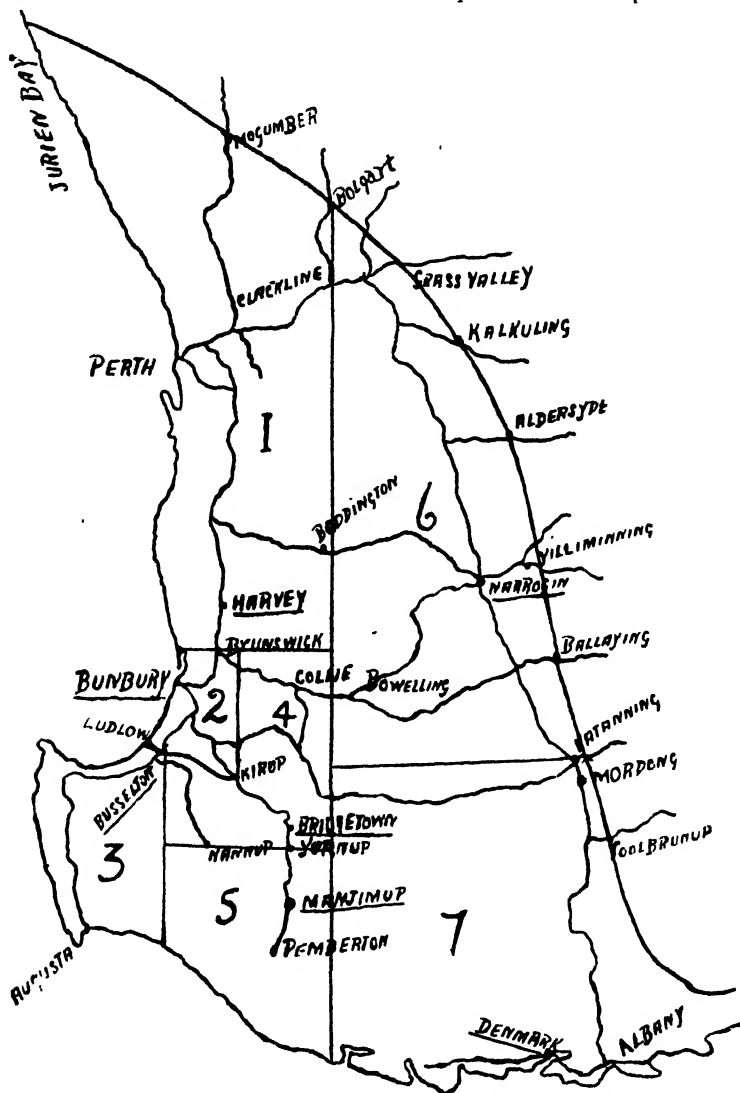
The addresses and names of Advisers are as follows:—Albany, A. C. Vaughan; Bridgetown, A. Flintoff; Bunbury, M. Cullity; Denmark, V. Cardon; Geraldton, G. L. Throssell, Government Buildings; Gosnells, R. C. Owen; Harvey, D. L. Breen (Fruit) and C. Giles (Dairying); Katanning, A. S. Wild; Manjimup, J. Ireland; Mundaring, V. Cahill; Northam, F. L. Shier; Northcliffe, A. Sharp; Vasse, J. M. Nelson.

THE BETTER DAIRYING COMPETITION.

1934.

G. K. BARON-HAY,
Superintendent of Dairying.

The Better Dairying Competition, which was inaugurated in 1932 by the West Australian Committee of the Australian Dairy Council with the main object of inducing farmers to increase the fodder available for their dairy stock, proved so valuable that it was decided to continue the competition for the year 1934.



Note.—The Southern boundary of Zone 6 is now a direct line through Mt. Barker.

As in previous years, judging was carried out by officers of the Dairy Branch, Department of Agriculture, the South-West portion of the State being divided into

seven zones as shown in the accompanying map, arranged as far as possible according to climatic and soil conditions (see map).

Farms were judged according to the attached scale of points, which had been slightly altered from that of previous years, so as to stress still further the value of fodder and its conservation.

The following handicaps also were imposed on those competitors who gained prizes during the previous year:—

First Prize winner	...	...	...	Deduct 15 points.
Second "	"	"	"	" 10 "
Third "	"	"	"	" 5 "
Fourth "	"	"	"	" 1 "

As in previous competitions, the advice of Mr. P. Rose, of Burekup, was of special value in framing the schedule of points for judging.



1.—Shield donated by Cuming Smith Mt. Lyell Farmers' Fertiliser Co.
To be held by the zone containing the four leading farmers.

CHAMPION DISTRICT SHIELD.

This handsome shield, donated by Messrs. Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., is awarded annually to that district or zone containing the four leading farms.

For the season 1932-33 the shield was won by No. 2 Zone, controlled by the Wellington Agricultural Society, Bunbury, the four leading farms being owned by:—

H. Noon, Katterup
Percy Rose, "Yeralla," Burekup
Norton Bros., Capel
J. Hearman, Donnybrook

The results for 1934 season are not yet available.

The main headings under which competitors were judged and points allotted were as follow:—

	Max. Points.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—	
(a) Hay—Quality, Condition	60
(b) Silage—Quality, Type, Wastage, etc.	60
(c) Summer Fodder Crops—Cultivation, Disease, Yield	50
(d) Amount conserved per cow	130
2. Pastures (200 points)—	
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150
(b) Management, Fertilisation	50
3. Dairy Herd (160 points)—	
(a) Breeding	50
(b) Dairy Type	50
(c) Condition and Freedom from Disease	30
(d) Herd Sire—(i) Pure-bred	20
(ii.) Ex tested Dam	10
4. Returns per Acre (120 points)—	
(a) Butter Fat.....lb. per acre	100
*Sidelines £.....per acre	20
5. Pigs (30 points)—	
(a) Breed, Type, and Condition	10
(b) No. of breeding Sows in proportion to milch Cows	10
(c) Housing, Feeding and Management	10
6. Farm Management (140 points)—	
(a) Lay-out, Convenience, etc.	50
(b) Sanitation: (i) General	30
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40
(c) Book-keeping and Records	20
7. Utilisation of Skim Milk (50 points)—	
Based on number of pigs reared and calf-months per cow	50
(5 months—1 calf—1 pig)	
Total	1000

* Pigs Poultry, Vegetables, etc.

A perusal of the above schedule will show the great importance attached to pasture, fodder crops, and fodder conservation by the Committee, as 500 from a total of 1,000 points were allotted for these items.

Owing to the large area covered by the competition, which provided varying climatic and seasonal conditions with annual rainfalls ranging from 20 to 70 inches, it was found necessary to judge the farms in zones at different periods of the year, as follows:—

Zone 1—Centre	Harvey	...	...	Jan. 15th to Feb. 15th, 1934
Zone 2	Bunbury	...	...	Jan. 1st to Jan. 30th, 1934
Zone 3	Margaret River	...	...	Feb. 1st to Feb. 28th, 1934
Zone 4	Bridgetown	...	...	Jan. 15th to Feb. 15th, 1934
Zone 5	Manjimup	...	...	Jan. 15th to Feb. 28th, 1934
Zone 6	Narrogin	...	...	Jan. 1st to Jan. 30th, 1934
Zone 7	Denmark	...	...	Feb. 1st to 28th, 1934

Prizes as follow were generously donated by the Committee of the Australian Dairy Council:—

First Prize in each Zone	... ..	£10 and framed Certificate
Second „ „ „	... ..	£6
Third „ „ „	... ..	£4
Fourth „ „ „	... ..	£3

The following tables, 1 to 7, set out in detail the points obtained by each competitor in the various zones.

TABLE 1. POINTS GAINED BY COMPETITORS IN ZONE 1.

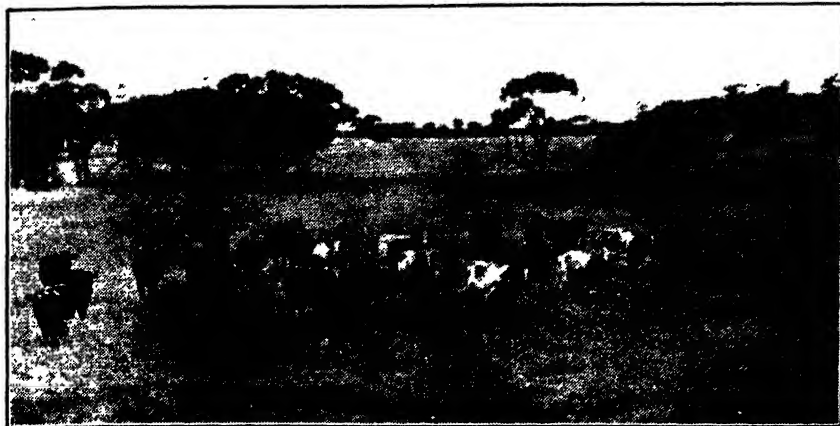
CENTRE: HARVEY AGRICULTURAL SOCIETY.

Judge H. G. Elliott, Agricultural Adviser, Dairy Branch.

	Maximum Points	S. F. Russell.	W. Shaw.	G. E. Scott.	S. Jowers.	T. Briggs.	C. H. Peterson.	Bee Bros.	A. Warburton.	A. E. Clifton.	F. S. Morris.	L. Temple.
1. Conservation of Fodder and Summer Fodder Crops (300 points)												
(a) Hay—Quality, Condition	60	55	56	51	55	51	54	51	53	51	53	...
(b) Silage—Quality, Type, Wastage, etc.	60	*50	*57	*50	55	52	56	53	*30	51	*35	*48
(c) Summer Fodder Crops Cultivation, Disease, Yield	50	48	48	43	38	45	45	36	42	36	42	40
(d) Amount conserved per cow	130	130	130	130	120	120	120	99	130	101	130	80
2. Pastures (200 points)												
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	137	146	141	131	133	132	120	131	126	130	138
(b) Management, Fertilisation	50	47	47	38	40	12	12	37	10	35	36	45
3. Dairy Herd (160 points)												
(a) Breeding	50	44	42	47	43	45	44	46	41	41	40	45
(b) Dairy Type	50	46	46	47	44	44	45	46	43	41	41	46
(c) Condition and Freedom from Disease	30	28	29	29	25	27	24	27	25	24	24	25
(d) Herd Sire: (i) Pure-bred	20	20	19	20	18	20	21	20	17	17	17	20
(ii) Ex tested Dam	10		7	8	4	7		10	8			
4. Returns per Acre (120 points)												
(a) Butter Fat, per acre	100	87	73	91	78	51	58	78	77	68	61	76
Side-lines (Pigs, Poultry, Vegetables, etc.), per acre	20	20	20	5	20	18	10	5	12	20	16	12
5. Pigs (30 points) —												
(a) Breed, Type, and Condition	10					8						8
(b) No. of breeding Sows in proportion to milch cows	10	+15	+15	+15	+15	5	+15	+15	+15	+15	+15	7
(c) Housing, Feeding, and Management	10	..	..	..	..	7	..	..	..	..	..	8
6. Farm Management (140 points)												
(a) Lay out, Convenience, etc.	50	47	44	38	38	44	39	43	43	39	40	46
(b) Sanitation												
(i) General	30	28	24	25	26	24	24	25	23	22	22	26
(ii) Milking Shed, Dairy Utensils and care of Cream and Milk	40	36	31	36	36	34	35	36	33	32	32	33
(c) Book-keeping and Records	20	17	13	14	15	14	12	12	13	11	10	17
7. Utilisation of Skim Milk (50 points) —												
Based on number of pigs reared and calf-months per cow	50	13	4	13	24	30	16	20	11	47	27	50
(5 months—1 calf 1 pig)												
Total	1,000	868	851	841	825	821	798	788	787	780	771	770
Handicap	...	-15	...	...	-1	-10	...	...	...	...	...	...
Total	...	853	851	841	824	811	798	788	787	780	771	770

* No silage, but irrigated pastures and summer fodders, kept during flush period.

+ Whole milk suppliers. Pigs only



2 —"Tipperary" Stud of Australian Shorthorn

The above herd, owned by the winner in Zone 6 (Narrogin), Mr W G Burges. Twenty cows completing test averaged 9,136 1 lbs Milk and 368 9 lbs Fat in 1933-34

TABLE 2. POINTS GAINED BY COMPETITORS IN ZONE 2.

CENTRE: BUNBURY AGRICULTURAL SOCIETY.

Judge: C. Giles, Dairy Instructor, Dairy Branch.

	Maximum Points	P. Rose	Flanagan Bros	A. Triggell	A. Frost.	W. J. Sears.	Norton Bros.	Dunkley Bros.	R. J. Triggell.	J. Hearman	W. W. Hutton	E. Fitzgerald.
1. Conservation of Fodder and Summer Fodder Crops (300 points)												
(a) Hay—Quality, Condition	60	52	50	78	85	15	132	145	120	48	100	...
(b) Silage—Quality, Type, Wastage, etc.	60	25	55									
(c) Summer Fodder Crops—Cultivation, Disease, Yield	50	40	30									
(d) Amount conserved per cow	130	104	47	77	64	104	30	32	100	130	16	...
2. Pastures (200 points)												
(a) Condition, Freedom from Weeds, Mixture, Drought resistance, etc.	150	110	125	100	120	105	120	118	106	105	100	100
(b) Management, Fertilisation	50	44	42	40	40	42	32	30	42	35	36	35
3. Dairy Herd (100 points)												
(a) Breeding	50	50	43	44	44	30	42	43	38	40	40	30
(b) Dairy Type	50	16	41	45	42	38	41	44	32	32	42	42
(c) Condition and Freedom from Disease	30	27	24	25	27	24	23	25	27	18	22	25
(d) Herd Sire (i) Pure-bred (ii) Ex tested Dam	20	20	20	20	20	18	18	20	20	17	15	20
4. Returns per Acre (120 points)												
(a) Butter Fat, per acre	100	49	53	100	100	52	64	49	15	25	31	64
(b) Sidelines (Pigs, Poultry, Vegetables, etc.), per acre	20	6	20	20	12	9	9	5	7	9	11	7
5. Pigs (30 points)												
(a) Breed, Type, and Condition	10	7	8	8	8	8	7	8	9	7	8	...
(b) No. of breeding Sows in proportion to milk cows	10	10	4	7	10	3	3	6	10	5	...	...
(c) Housing, Feeding, and Management	10	8	9	7	8	7	6	9	9	5	6	...
6. Farm Management (110 points)												
(a) Lay-out, Convenience, etc.	50	45	45	38	40	41	40	35	42	35	43	35
(b) Sanitation:												
(i) General	30	28	28	22	24	25	25	22	26	25	28	22
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	35	36	28	32	30	32	28	32	30	36	30
(c) Book-keeping and Records	20	20	18	15	16	15	18	18	14	15	17	10
7. Utilisation of Skim Milk (50 points)												
Based on number of pigs reared and calf-months per cow .. (5 months 1 calf 1 pig)	50	50	30	50	20	30	50	50	50	10	43	22
Total	1000	786	728	724	721	707	702	695	693	678	604	442
Handicap .. ..	..	-10	..	..	..	..	5	..	..	-1	..	..
Total .. ..	..	776	728	724	721	707	697	695	693	677	604	442

TABLE 3.—POINTS GAINED BY COMPETITORS IN ZONE 3.
CENTRE: BUSSEYON AGRICULTURAL SOCIETY.
Judge: J. M. Nelson, Dairy Supervisor, Dairy Branch.

	Max. Points.	A. Millar.	(H. Frommenger.	(V. Vasselton.	M. Torrent.	J. W. (Dahfeld.	A. Wilkinson.	A. W. Langley.	A. White.	J. J. Burre.	(V. Taylor.	J. Illeney.	G. Smith.	A. Mele.	H. Johnson.	W. J. Johnson.	J. Angell.	T. Hulter.	W. Key.	W. Beetham.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—																				
(a) Hay—Quality, Condition	60	40	43	50	45	45	50	45	50	55	45	48	46	45	43	47	47	55	40	45
(b) Silage—Quality, Type, Wasteage, etc.	60	36	45	45	45	55	45	45	45	50	50	50	50	50	52	40	40	50	45	50
(c) Summer Fodder Crops—Cultivation, Disease, Yield	130	35	30	45	43	114	30	117	120	119	122	114	125	116	118	118	115	113	120	120
(d) Amount conserved per cow	130	124	125	123	114	128	112	117	120	119	122	114	125	116	118	118	115	113	120	120
2. Pastures (200 points)—																				
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	115	110	110	112	110	120	113	100	100	115	100	113	105	95	100	114	115	100	105
(b) Management, Fertilisation	50	40	40	45	40	40	36	40	35	40	40	40	43	40	45	45	40	45	40	45
(c) Breeding	50	40	45	40	38	40	40	40	40	40	40	42	45	42	40	40	42	42	35	40
(d) Dairy Type	50	40	45	42	40	40	43	40	40	42	45	45	45	45	38	40	40	45	38	40
(e) Condition and Freedom from Disease	30	27	27	27	26	25	28	27	25	28	25	26	26	26	26	24	26	27	25	25
(f) Herd Sire—(i) Pure-bred	20	18	18	16	8	12	12	10	17	17	12	16	16	16	16	16	16	17	5	10
(g) Ex tested Dam	10	10	5	8	8	8	8	8	5	5	5	7	5	4	5	5	5	6	5	5
3. Returns per Acre (120 points)—																				
(a) Butter Fat (per acre)	100	74	57	60	99	68	100	94	66	56	87	60	65	49	61	31	74	47	79	53
(b) Fat (per acre)	20	12	12	12	17	14	14	12	5	10	10	10	10	12	12	10	10	12	10	17
4. Pigs (80 points)—																				
(a) Breed, Type, and Condition	10	8	8	8	8	8	8	8	8	5	8	8	8	5	7	4	8	9	8	5
(b) No. of breeding Sows in proportion to milch Cows	10	6	3	8	8	8	5	7	5	8	8	8	8	5	8	7	8	8	5	5
(c) Housing, Feeding and Management	10	8	6	8	8	8	8	7	6	8	8	8	8	5	8	7	8	8	5	5
5. Farm Management (140 points)—																				
(a) Lay-out, Convenience, etc.	50	38	35	38	35	40	35	36	35	40	40	40	40	36	40	35	43	35	35	35
(b) Sanitation:																				
(i) General	30	27	25	25	25	28	25	27	23	28	25	25	27	27	25	24	20	28	26	25
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	35	36	38	32	35	32	34	35	35	33	36	36	36	36	36	34	36	33	30
6. Utilisation of Skim Milk (50 points)—																				
Based on number of pigs reared and calf-months per cow	50	35	40	35	35	35	36	35	32	30	36	30	30	33	32	30	35	38	30	35
(5 months—1 calf—1 pig)																				
Total	1000	780	755	750	748	747	746	742	737	723	715	714	709	709	708	707	699	694	693	692

* Pigs, Poultry, Vegetables, etc.



3—Rotational Sowing of Maize for Summer Fodder on Mr. S. F. Russell's Farm, Serpentine.
Winner in Zone 1 (Harvey)

TABLE 4.—POINTS GAINED BY COMPETITORS IN ZONE 4.

CENTRE: BRIDGETOWN AGRICULTURAL SOCIETY.

Judge: C. Gilles, Dairy Instructor, Dairy Branch.

	Maximum Points	C. Pearce	H. E. Kendall	G. E. White	V. A. Dousa	T. Gibblett	A. Hayward	S. C. Maidment
1. Conservation of Fodder and Summer Fodder Crops (300 points)—								
(a) Hay—Quality, Condition	60	88	80	48	50	80	45	50
(b) Silage—Quality, Type, Wastage, etc.	60			42	48		42	52
(c) Summer Fodder Crops—Cultivation, Disease, Yield	50				5			
(d) Amount conserved (per cow)	130	64	77	79	11	39	70	65
2. Pastures (200 points)								
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	120	100	115	125	120	100	100
(b) Management, Fertilisation	50	40	40	44	45	40	40	42
3. Dairy Herd (160 points)								
(a) Breeding	50	45	42	42	32	40	42	37
(b) Dairy Type	50	45	42	40	40	42	40	41
(c) Condition and Freedom from Disease	30	28	27	26	25	28	25	20
(d) Herd Sire (i) Pure-bred	20	20	20	20	10	20	18	18
(ii) EA tested Dam	10	10	10	5			10	
4. Returns per Acre (120 points)								
(a) Butter Fat (per acre)	100	48	38	48	56	58	52	34
*Sidelines (per acre)	20	6	12	6	16	15	5	13
5. Pigs (30 points)								
(a) Breed, Type, and Condition	10	10	8	8	8	5	8	6
(b) No. of breeding Sows in proportion to milch cows	10	10		10	5	5	5	12
(c) Housing, Feeding and Management	10	8	7	7	8	5	5	5
6. Farm Management (140 points)								
(a) Lay-out, Convenience, etc.	50	46	40	42	42	44	35	35
(b) Sanitation:								
(i) General	30	22	22	20	22	25	20	20
(ii) Milking Shed, Dairy, Dairy Utensils and care of Cream and Milk	40	35	35	30	32	35	30	30
(c) Book-keeping and Records	20	18	15	15	16	20	17	17
7. Utilisation of Skim Milk (50 points)								
Based on number of pigs reared and calf-months per cow								
(5 months 1 calf—1 pig)	50	24	33	16	30	25	30	34
Total	1000	693	677	663	656	652	634	621

TABLE 5. POINTS GAINED BY COMPETITORS IN ZONE 5.

CENTRE : MANJIMUT AGRICULTURAL SOCIETY.

Judge : A. Sharp, Dairy Supervisor, Dairy Branch.

	Maximum Points.	H. C. Barnsby.	G. F. Coombs.	H. Brown.	A. G. Abbott.	S. Gray.	W. Ham.	A. N. Hilditch.	L. Preston.	G. T. N. Downes.	G. Jackson.	H. F. Jay.
1. Conservation of Fodder and Summer Fodder Crops (300 points)—												
(a) Hay—Quality, Condition	60	52	35	46	44	40	50	50	42	40	40	45
(b) Silage—Quality, Type, Wastage, etc.	60	54	44	55	44	44	52	46	48	50	48	...
(c) Summer Fodder Crops—Cultivation, Disease, Yield	50	20	...	20	15	23	...	4	...	12	9	24
(d) Amount conserved per cow	130	125	130	80	100	97	95	125	125	88	106	40
2. Pastures (200 points)—												
(a) Condition, Freedom from Weeds Mixture, Drought-resistance, etc.	150	105	95	100	80	110	90	100	70	80	95	80
(b) Management, Fertilisation	50	40	37	40	46	32	40	40	34	34	38	40
3. Dairy Herd (160 points)												
(a) Breeding	50	40	50	40	45	36	40	35	45	38	38	38
(b) Dairy Type	50	44	45	42	40	38	38	33	42	36	35	41
(c) Condition and Freedom from Disease	30	26	24	23	23	22	22	19	22	22	21	22
(d) Herd Sire :												
(i) Pure-bred	20	20	20	20	20	18	20	20	20	20	20	20
(ii) Ex tested Dam	10	10	10	10	10	...	10	10	10	10	...	10
4. Returns per Acre (120 points)												
(a) Butter Fat, per acre	100	73	71	62	52	76	51	40	41	58	42	76
Sidelines (Pigs, Poultry, Vegetables, etc.), per acre	20	16	...	8	3	3	...	...	...	...	...	5
5. Pigs (30 points)												
(a) Breed, Type and Condition	10	7	6	5	6	6	5	5	5	2	5	5
(b) No. of breeding Sows in proportion to milch Cows	10	8	5	6	7	4	6	8	1	...	6	8
(c) Housing, Feeding and Management	10	8	7	7	8	7	6	6	7	5	6	6
6. Farm Management (140 points)—												
(a) Layout (Convenience, etc.)	50	36	36	32	45	34	31	32	35	31	31	29
(b) Sanitation :												
(i) General	30	26	25	23	28	24	24	20	21	25	23	21
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	36	34	34	35	25	34	32	35	32	26	32
(c) Book-keeping and Records	20	16	15	13	12	5	17	2	3	12	4	17
7. Utilisation of Skim Milk (50 points)—												
Based on number of pigs reared and calf-months per cow ... (5 months—1 calf—1 pig)	50	42	33	14	13	13	19	12	11	15	5	15
Total	1000	804	722	680	676	657	653	639	623	610	598	574
Handicap	...	15	1	5	...	10	...	...	...	...	...	...
Total	...	789	721	675	676	647	653	639	623	610	598	574

ZONE 6—CENTRE, NARROGIN.

This Zone (see map) embraces land lying either side of the Great Southern Railway from approximately Northam to Kendenup, the rainfall varying from 17 to 25 inches.

Whilst, primarily, this land was considered as suitable for oat growing and the rearing of sheep, the production of butter fat in the district also has more than doubled during the last three years, and those farmers owning cattle have made dairy farming a permanent adjunct to their system of farming.

The most important factor for success with all stock-rearing activities in this Zone is fodder conservation.

The committee, therefore, decided to continue the special competition inaugurated last year, designed specifically to encourage fodder conservation, judging being conducted according to the following scale of points:—

Fodder conserved per head of dairy cows	...	...	50	points.
Hay—Quality and condition	...	...	50	"
Silage and/or Summer Fodder Crops	...	...	100	"
Use of Phosphatic Licks	...	...	25	"
Sanitation of Dairy Premises	...	...	25	"
Total	...	...	250	"

Details of the points gained by each competitor are shown in Table 6, winners in the competition last year being handicapped as follows:—

First Prize winner	...	...	...	...	Deduct 5 points.
Second	"	"	...	...	3 "
Third	"	"	...	...	1 "



4.—Giant Jersey Kale grown by C. Candy, Mt Barker, as Summer Fodder

TABLE 6.—POINTS GAINED BY COMPETITORS IN ZONE 6

CENTRE: NARROGIN AGRICULTURAL SOCIETY.

Judge: H. G. Elliott, Agricultural Adviser, Dairy Branch

Competitor.	Handicap.	Fodder Conserved per Head	Hay Quality Condition.	Silage	Summer Fodder Crop	Use of Phosphatic Lick	Sanitation of Dairy Premises	Total Points.
		50.	50.	100		25	25	250.
W. G. Burges	5	50	48	90		25	23	240
R. Loyne	...	46	44	...	90	25	22	227
T. A. Hardie & Son	...	50	47	...	75	25	23	220
R. McDougall	...	50	46	...	77	25	21	219
J. L. Williamson	...	50	38	85		25	20	218
G. Webb	...	40	40	87		25	10	211
L. P. James	...	38	38		96	25	11	210

* Fodder conserved per head based on a conservation of 2½ tons hay and 2 tons of silage or green material per cow

Where both Silage and Fodder Crops are provided, the scale of points to be halved in these sections, so that their total remains 100.

The necessity for ample fodder reserves for all classes of farm stock apparently is realised by farmers in this Zone—with its natural disability of low rainfall—to a far greater extent than by farmers in areas with heavier rainfalls.

This is shown in the following table, which indicates that in Zone 6 the average conservation of fodder calculated as hay is 5.83 tons per cow, or more than three times that in other Zones. This undoubtedly accounts for the excellent herd productions recorded by leading farmers in this district.



5.—Stack of clover silage built by Langley & Sons, Cowaramup. Estimated to contain 100 tons

TABLE 7.—FODDER CONSERVED PER COW IN GREAT SOUTHERN DISTRICTS COMPARED WITH AVERAGE FOR SOUTH-WEST ZONES.

	Fodder Reserve per Cow.				Total Reserve calculated as Hay (Tons).*	
	Hay (Tons).		Silage (Tons).			
	1932-33.	1933-34.	1932-33.	1933-34.	1932-33.	1933-34.
Zone 6 ...	2.9	4.9	3.3	2.8	4.00	5.83
Other Zones ...	1.21	1.49	1.16	0.89	1.60	1.79

* 1 ton hay ... 3 tons silage.

During the last two years the competition has shown that meadow hay can be grown in the Great Southern districts having 17 inches of rain. No less than five of the seven competitors had meadow hay on hand, a total of 282 tons being cut on the five properties. The judge, Mr. H. G. Elliott, remarks that the quality of this hay was superior to that seen during the previous year, owing to having been cut earlier in the season.

It is pleasing to note that all competitors were feeding di-calcic phosphatic lick to their stock, as this practice is considered essential to the health of stock throughout the summer months.

TABLE 8. - POINTS GAINED BY COMPETITORS IN ZONE 7

(CENTRE: DENMARK AGRICULTURAL SOCIETY.)

Judge: V. A. Cardon, Dairy Supervisor, Dairy Branch.

	Max. Points.	J. J. Daly	P. Her-ridge	S. L. Anning.	A. Smith.
1. Conservation of Fodder and Summer Fodder Crops (300 points) -					
(a) Hay—Quality, Condition	60	50	55	50	40
(b) Silage—Quality, Type, Wastage, etc.	60	30	40	55	..
(c) Summer Fodder Crops—Cultivation, Disease, Yield	50	45	30	*35	30
(d) Amount conserved per Cow	130	120	130	100	90
2. Pastures (200 points)—					
(a) Condition, Freedom from Weeds, Mixture, Drought-resistance, etc.	150	120	120	130	100
(b) Management, Fertilisation	50	40	40	40	30
3. Dairy Herd (160 points) -					
(a) Breeding	50	45	40	35	35
(b) Dairy Type	50	40	40	40	35
(c) Condition and Freedom from Disease	30	28	25	25	20
(d) Herd Sire (i) Pure-bred	20	15	19	18	20
(ii) Ex tested Dam	10	.	10	10	10
4. Returns per Acre (120 points)					
(a) Butter Fat (per acre)	100	90	95	80	100
*Sideliness (per acre)	20	20	8	10	.
5. Pigs (30 points) -					
(a) Breed, Type, and Condition	10	8	8	5	
(b) No. of breeding sows in proportion to milch cows	10	4	6	6	
(c) Housing, Feeding and Management	10	8	7	4	
6. Farm Management (140 points)					
(a) Lay-out, Convenience, etc.	50	40	35	35	30
(b) Sanitation:					
(i) General	30	28	28	20	25
(ii) Milking Shed, Dairy, Dairy Utensils, and care of Cream and Milk	40	38	32	30	25
(c) Book-keeping and Records	20	12	15	10	...
7. Utilisation of Skim Milk (50 points)					
Based on number of pigs reared and cal-months per cow	50	45	40	35	30
(5 months 1 calf 1 pig)					
Total	1000	826	823	773	620

* Pigs, Poultry, Vegetables, etc

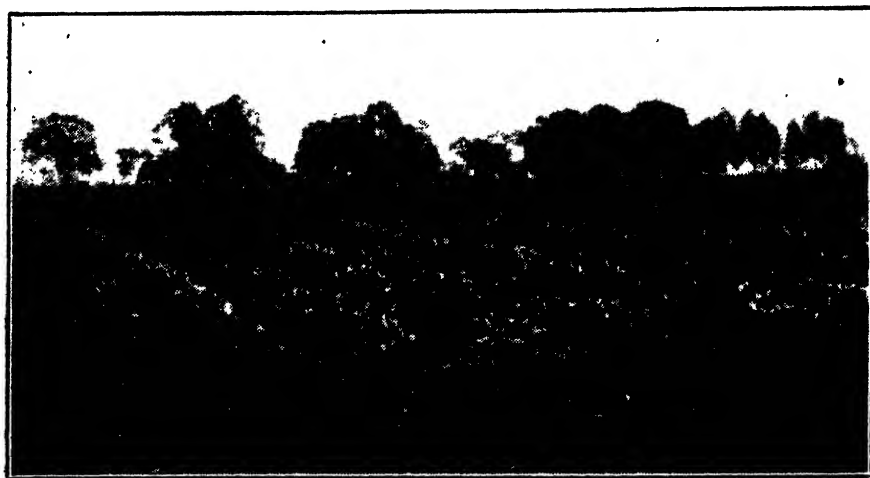
LESSONS FROM THE COMPETITION.

The Better Dairying Competition has been conducted for three years, and during that period no less than 196 farms have been visited and carefully judged by officers of the Dairy Branch, Department of Agriculture. A perusal and study of the tables below give valuable and, it is believed, accurate information regarding essential factors for success in dairying in Western Australia, and it is remarkable how consistent these factors have been during the three years that the competition has been conducted.

1.—CONSERVATION OF FODDER AND SUMMER CROPS.

Conservation of fodder is believed to be the most important factor in successful stock husbandry in Western Australia, and it is significant throughout the competition that the most successful farmers—not only from the point of view of gaining a place in the competition but from that of being considered sound stockmen—are those with the greatest tonnage of conserved fodder per head of stock.

The object of the Western Australian Committee of the Australian Dairy Council, when initiating the competition, was to interest farmers in permanent pasture production and to conserve greater quantities of fodder for summer consumption, and it is gratifying to note that these objects have been progressively achieved during the last three years.



6.—Second Growth of Cow Peas S. F. Russell, Serpentine. This summer growing legume has been grown with great success in the South-West.

Table 9 shows the total fodder conserved per cow in each Zone compared with that of the leading competitor.

TABLE 9.—TOTAL FODDER CONSERVED PER COW.

	Cows.	Hay.	Silage.	Reserve per Cow.*		Reserve per Cow calculated as Hay.*
				Hay.	Silage.	
		tons.	tons.	tons.	tons.	
Zone 1 (Harvey)—Average ...	379	466	193	1.23	0.51	1.40
C. H. Peterson ...	22	26	30	1.19	1.37	1.65
Zone 2 (Bunbury)—Average ...	396	473	213	1.19	0.54	1.37
P. Rose ...	62	182	40	2.99	0.65	2.21
Zone 3 (Margaret River)—Average ...	383	685	316	1.79	0.82	2.06
J. H. Oldfield ...	18	57	59	3.17	3.28	4.26
Zone 4 (Bridgetown)—Average ...	179	285	146	1.60	0.80	1.87
G. E. White ...	26	44	52	1.70	2.00	2.39
Zone 5 (Manjimup)—Average ...	222	460	477	2.10	2.10	2.80
G. Jackson ...	11	43	22	3.91	2.00	4.57
Zone 7 (Denmark)—Average ...	74	89	87	1.20	1.20	1.60
L. S. Anning ...	15	29	28	1.93	1.87	2.55
Average all Zones, 1933-34 ...	1,633	2,447	1,432	1.49	0.89	1.79
1932-33 ...	1,531	1,854	1,784	1.21	1.16	1.60
1931-32 ...	1,502	1,605	931	1.06	0.71	1.33

* 1 ton hay = 3 tons silage.

A perusal of Table 9 shows that for the present year the average fodder conserved per cow was 1.79 tons reckoned as hay. While this average figure is higher than that for the two previous years, the goal of 2½ tons per cow—which is considered adequate—has not yet been reached, except in individual cases.

It will be noticed that individual competitors in each Zone have attained 2½ tons per cow, the performances of Messrs. P. Rose with a large herd of 62 cows, J. H. Oldfield with 4.26 tons per cow, G. E. White with 2.39 tons per cow, G. Jackson with 4.57 tons per cow and L. S. Anning with 2.55 tons per cow being of particular merit, and indicate that the goal is not an impossible one.

The average conservation in Zone 3 (Margaret River) and Zone 5 (Manjimup) is excellent, and it is informative to know that nearly all competitors in these districts were operating under the Group Settlement Scheme.

TABLE 10. COMPARISON OF FODDER CONSERVED PER COW IN 1931-32, 1932-33, and 1933-34.

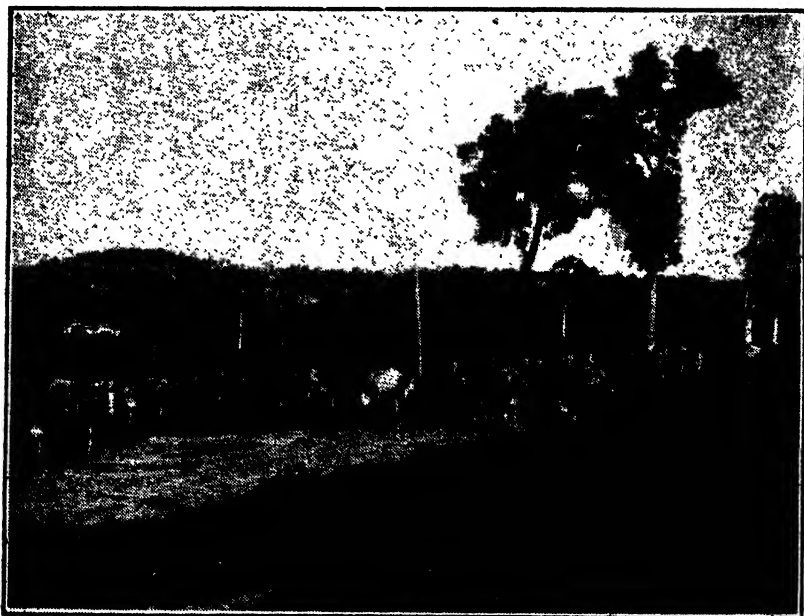
Zone.	Reserve per Cow.						Total Reserve Calculated as Hay (Tons).*		
	Hay (Tons).			Silage (Tons).					
	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.
1 ...	1.23	0.92	0.76	0.51	1.00	0.24	1.40	1.25	0.84
2 ...	1.19	1.02	0.40	0.54	0.50	0.40	1.37	1.19	0.53
3 ...	1.79	1.38	1.12	0.82	1.14	0.90	2.06	1.75	1.42
4 ...	1.60	0.94	1.23	0.80	0.81	0.75	1.87	1.25	1.48
5 ...	2.10	1.58	1.53	2.10	2.20	0.71	2.80	2.37	1.76
7 ...	1.20	2.11	1.62	1.20	2.20	0.71	1.60	2.66	1.86
Ay. all Zones	1.49	1.21	1.06	0.89	1.16	0.74	1.79	1.60	1.33

* 1 ton hay = 3 tons silage.

Table 10 shows the improved farming methods being adopted by competitors since the inception of the competition in 1931. During the three years fodder conservation has increased from 1.33 tons per cow to 1.6 tons in 1932-33 or 20 per cent. increase, while a further increase to 1.79 tons was effected in 1933-34, or an increase of 32 per cent. since the inception of the campaign.

It is believed that the example of individual competitors will be emulated by a greater proportion of other farmers in each district year by year, leading to higher production per cow and greater net returns.

Table 10 also shows that each year greater meadow hay reserves per cow were conserved, while silage conserved fluctuated in amount. This fluctuation undoubtedly is due to a seasonal factor. Where the spring is a dry one as in 1933-34, conditions may be unsuitable for the conserving of silage and more hay is conserved. The special benefit of silage is that it lengthens the time during which harvesting can be carried out, and also that in a specially favourable season for pasture growth it enables the farmer to save such surplus feed, which, if left until hay-cutting time, might be too great an area or tonnage to be handled with the labour available.



7.—Mr. P. Rose's Herd of Pedigreed Jersey Cows, "Yeeralla," Burekup. Average production of 64 cows' 281 lbs. butter fat, without allowance for age.

TABLE 11.—ACREAGE OF GREEN FODDER PER COW.

Zone.				Summer Fodders.	Acres sown per cow.
				acres.	
1.	Harvey	...	...	110.0	0.290
2.	Bunbury	...	...	16.3	0.040
3.	Margaret River	...	...	33.0	0.090
4.	Bridgetown	...	...	1.5	0.001
5.	Manjimup	...	...	29.0	0.130
7.	Denmark	...	...	40.5	0.550
Total				230.3	0.141
6.	Narrogin	...	...	113.0	1.00

GREEN SUMMER FODDER CROPS.

Table 11 sets out the average area sown to fodder crops per cow for each of the seven Zones. It will be noticed that in all Zones except Zone 7 (Denmark) and Zone 6 (Narrogin) the area sown is lamentably small. If the quantity of silage conserved were adequate there might be some justification for small areas of summer crops. As has been shown above, however, the quantity of silage conserved varies with the season, and in 1933-34 the amount conserved was below the amount considered necessary.

For some reason the sowing of summer crops is generally unpopular, as is shown by their consistent neglect—except in the two Zones mentioned above—during the three years of the competition, as is indicated in Table 12. The chief factors for this unpopularity are believed to be those of expense and the uncertainty of results.

TABLE 12.—ACREAGE OF GREEN FODDER GROWN PER COW.

Zone.				1931-32.	1932-33.	1933-34.
1.	Harvey	...	...	0.09	0.19	0.29
2.	Bunbury	...	...	0.08	0.04	0.04
3.	Margaret River	...	...	0.12	0.14	0.09
4.	Bridgetown	...	...	0.14	0.02	0.001
5.	Manjimup	...	...	0.13	0.14	0.130
7.	Denmark	...	...	0.32	0.38	0.550
Total				0.14	0.127	0.141
6.	Narrogin	...	...	...	1.56	1.00

It is not uncommon to find such crops as maize sown with expensive fertiliser mixtures, with dressings per acre ranging from 4 to 8 cwt. Maize variety trials and fertiliser trials carried out by the Department of Agriculture over a number of years indicate that such dressings are uneconomical, and that where heavy yields have been so obtained the cost is excessive. The most economical dressing for such summer crops is 3 cwt. of superphosphate and ammonia No. 3 per acre. For those desirous of mixing their own fertilisers, this fertiliser consists of superphosphate, 2½ parts, and sulphate of ammonia, 1 part.

The varying success obtained in the growing of summer crops undoubtedly is due to lack of thorough cultivation of the soil, and, where farmers feel they are unable to give the land the cultivation thought necessary, they would be well advised to desist wasting money on seed and expensive fertilisers—this latter necessity, however, is rather a reflection on capacity for crop husbandry.

One of the special needs for dairy stock during the summer months is an adequate supply of protein nutrients obtainable usually as clover hay or clover silage, the latter for preference.

The cow pea (*Vigna sinensis*) has given very promising results during the last two years in Western Australia and, it is believed, will prove a valuable means of supplementary silage as a source of protein during summer months.

The writer is convinced that further attention to the growing of summer fodders is essential to enable dairy stock to produce to their capacity.

Table 13 shows that in those districts where natural advantages for pasture production are lacking, farmers realise the necessity for the provision of adequate fodder during summer months, and special efforts are made to supply the deficiency; the average conservation in the Great Southern area being 3½ times that for the wetter districts in the South-West.

TABLE 13.—FODDER CONSERVED PER COW IN WET DISTRICTS, COMPARED WITH THAT IN DRY AREAS.

Zones.	Hay. Tons.	Silage. Tons.	Total Reserve per Cow calcul- ated as Hay. Tons.
Average—All Zones in Wet Districts ...	1.49	0.89	1.79
Average—Zone 6 (Narrogin) ...	4.90	2.80	5.83

Zones 1-5 and 7 receive 30ins. to 60ins. rainfall : Zone 6 only receives 17ins. to 25ins.

8.—Nine cows from Mr. W. G. Burges's herd, "Tipperary," York.
 "A tribute to conservation of fodder."



Kurrawong Kathleen 5th 11,328 lbs. Milk : 456.8 lbs. Fat	Kariawarra Plum 3rd 10,956 lbs. Milk : 422.7 lbs. Fat at 4 yrs.	Parkview Polly 2nd. 9,219 lbs. Milk : 363.9 Fat at Jr. 2 yrs.
Karrawarra Lofty 2nd. 9,411 lbs. Milk : 380.2 lbs. Fat at 3 yrs.	The Hill Sally 12,297 lbs. Milk : 497.9 lbs. Fat at 4 yrs	Kurrawong Kitty 8th. 11,535 lbs. Milk : 525.9 lbs. Fat.
Vall-h Farm Maggie 2nd 13,233 lbs. Milk : 508.9 lbs. Fat at 3 yrs	Widgee Waa Beauty 7th. 6,099 lbs. Milk : 244.7 lbs. Fat at 2 yrs.	The Hill Empress 4th. 8,709 lbs. Milk : 363.3 lbs. Fat at 3 yrs.

All above tests are for 273 days.

BUTTER FAT PRODUCTION.

The quality of dairy cows in herds owned by competitors has shown a distinct improvement this year, judging by production per cow, the improvement being ascribed almost solely to more adequate fodder being available throughout the whole lactation period.

As an indication of the realisation of the value of breeding, it is pleasing to record that practically every competitor owned pure bred bulls, the number of bulls of the different breeds being shown in Table 14.

TABLE 14.

The Percentage of Bulls in Use according to Breed.

Breed.					1932-33. per cent.	1933-34. per cent.
Jersey	...	...	...	...	66.0	57.5
Guernsey	...	...	...	...	18.0	17.5
Australian Illawarra Shorthorn	...	...	...	...	11.0	15.0
Ayrshire	...	...	...	...	5.0	5.0
Friesian	...	...	...	...	...	5.0
Total	...	...	...	...	100.0	100.0

1,633 cows were entered for the competition, being an increase of 100 over that of last year, the average production being 208.8 lbs. of butter fat per cow as compared with 201.5 lbs. during 1932-33.

While only six competitors owned herds producing more than 250 lbs. fat per cow in 1932-33, no less than 14 herds exceeded this figure during the present year, the names of these owners being shown in Table 15. It also will be noticed that four herds exceeded 300 lbs. butter fat per cow compared with only one in 1932-33.

TABLE 15.

Owner.	No. of Cows in Herd.	Production per Cow - lbs. Butter Fat.
A. Trigwell, Donnybrook	17	323.0
S. Bowers, Brunswick	24	322.4
W. Shaw, Harvey	41	319.3
G. Scott, Yarloop	18	319.1
S. F. Russell, Serpentine	32	288.5
A. Millar, Forest Grove	21	287.7
S. Smith, Cowaramup	11	287.4
H. C. Barnsby, Pemberton	19	279.6
P. Rose, Burekup	62	271.8
L. Temple, Harvey	21	258.6
G. F. Combs, Jardee	24	258.3
C. Casselton, Wonerup	21	254.7
A. Wilkinson, Yoongarilup	18	252.5
Dunkley Bros., Capel	52	250.7
Total cows	381	...
Average	27.2	291.0

Table 16 sets out the average production per cow in each zone, together with that of the highest producing herd in each zone.

The very creditable yields of cows in the leading herds in Zones 1, 2, 3, and 5 will be noticed, and in each case these herds have been bred by their owners by a definite policy of herd improvement by the use of pure bred bulls and careful attention to feeding.

TABLE 16.

Average Production per Cow in each Zone, together with that of the Highest Producing Herd.

Zone.	No. of Cows.	Ave age Cows in Herd.	Average Butter Fat per Cow. lbs.
1. Harvey	379	35.4	221.5
S. Bowers, Brunswick ...	...	24.0	322.4
2. Bunbury	396	36.0	223.4
A. Trigwell, Donnybrook ...	...	17.0	323.0
3. Margaret River	383	21.3	199.6
A. Miller, Forest Grove ...	...	21.0	287.7
4. Bridgetown	179	25.6	181.1
C. Pearse, Kirup ... ..	...	16.0	228.0
5. Manjimup	222	21.8	194.4
H. C. Barnsby, Pemberton ...	...	19.0	279.6
7. Denmark	74	18.5	207.3
P. Berridge, Denmark ...	...	20.0	221.8
Average, all Zones	272.2	26.3	208.8

The yields of the 1,633 cows milked by competitors this season confirm the statement made last year that the average production of dairy cows in the South-West is considerably higher than the State average and approximates 180 lbs. butter fat per cow per annum. It also is significant that in the Bridgetown Zone, where fodder conservation and green "summer" fodder production were low, there was a serious fall in the average production per cow as compared with that for the previous year, namely, a decrease from 205 lbs. in 1932-33 to 181 lbs. fat per cow in 1933-34.

BUTTER FAT PER ACRE.

Table 17 sets out the average production of butter fat per acre, and also the average for the six leading farms in the competition.

TABLE 17.

Average Production of Butter Fat per Acre in each Zone, compared with that of the leading Competitor.

Zone.	Acres devoted to Dairying per Farm.	Average No. of Cows per Herd.	Butter Fat per Acre.		
			1933-34.	1932-33.	1931-32.
1. Harvey—Average	123.8	35.4	61.6	34.8	53.4
S. F. Russell	118.0	32.0	78.2	...	...
2. Bunbury Average	244.7	36.0	32.8	46.6	50.4
P. Rowe	450.0	62.0	37.4	...	...
3. Margaret River—Average	91.0	21.3	46.6	43.6	37.9
A. Miller	117.0	21.0	52.0	...	...
4. Bridgetown—Average	134.4	25.6	35.7	40.7	35.1
C. Pearse	100.0	16.0	36.4	...	...
5. Manjimup—Average	85.3	21.8	46.0	38.8	35.5
H. C. Barnsby	77.0	19.0	57.0	...	...
7. Denmark—Average	55.0	18.5	70.0	49.4	45.4
J. J. Daly	90.0	28.0	66.9	...	...
Average, all Zones	126.7	26.3	43.8	42.6	43.0
Average, 6 leading Farms ...	158.7	20.7	48.6	54.0	49.0

A comparison of the average figures for the three seasons for which information is available indicates how remarkably close the production figures are for each year, and it is believed that these figures give a reliable guide to what may be expected from average land in the South-West under reasonably good management.

In spite of the great variation in the production of the herds, the average production per acre approximates very closely to that of the six leading herds and indicates that *management* plays an important part in net profit from a dairy farm irrespective of the production of the cows.

The results over the three years show that with good management 50 lbs. of butter fat per acre may be expected, though a return of 43 lbs. per acre would be a general average. This is also an indication of the average value of our dairy lands, namely, the capitalisation of the value of 43 lbs. of butter fat per acre. This figure is corroborated by the information in Table 18, which sets out the average area required to support a milking cow or a cow unit which includes, of course, the attendant heifers, horses, and a bull. It is estimated that a 20 milking cow or 20 cow-unit farm will comprise 50 stock, as set out below:—

20-Cow Units.

20 Cows
9 Heifers 2 years old
9 " yearlings
9 " calves
1 Bull
2 Horses
—
50 Total.
—

Ten per cent. allowed for losses.

TABLE 18.

Acres utilised per Milking Cow.

Zone.	Average No. of Cows in Herd			Acres devoted to Dairy-ing.			Acres per Cow.		
	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.
1. Harvey ...	35.7	31.7	31.7	123.8	150.7	138.9	3.6	4.8	4.4
2. Bunbury ...	36.0	42.2	43.5	244.7	207.5	247.7	6.8	4.6	5.1
3. Margaret River ...	21.3	20.6	19.0	91.0	88.8	81.5	5.8	4.3	4.3
4. Bridgetown ...	25.6	23.3	17.6	134.4	117.4	96.1	5.3	4.4	5.5
5. Manjimup ...	21.8	23.2	17.1	85.3	118.1	92.4	4.2	5.1	5.4
7. Denmark ...	18.5	19.0	13.7	55.0	85.1	57.4	3.0	4.5	4.2
Average, all Zones ...	26.3	25.5	23.7	126.7	120.6	119.0	4.7	4.7	4.9

It thus will be seen that, although a cow-unit or milking-cow requires 4.7 acres, this is equivalent to the high carrying capacity of 1.9 acres per head, without other stock, such as pigs, etc.

The figures in Table 19 confirm the statement made in the report of the competition in 1932-33, that an unirrigated farm of 100 acres is fully stocked with a herd of 20 milch cows and that, except in specially favoured areas, a dairy farm of less than 100 acres is not a sound proposition, as it is considered that a herd of 20 cows is necessary to maintain a family in comfort and meet all liabilities.

PIGS.

As pointed out last year, there was a serious fall in the number of pigs, particularly sows, owned by competitors, the reason given being the low prices ruling for pork and bacon, which were unprofitable. Even at the low prices then ruling, however, it has been shown by some competitors that by breeding pigs, as opposed to purchasing, and by growing as much fodder as possible, bacon could be produced at a profit.

Low prices for pig products continued until January, 1934, and the number of sows was found to have still further diminished, so that many farmers are not now in a position to take advantage of the remunerative prices offering. Experience has shown that it is not sound policy to sell or slaughter breeding sows, as they can be maintained very cheaply, and the "price-cycle" for pig products, according to German investigations, is from two to three years. Without good breeding sows the farmer will find it difficult to rapidly increase numbers, and at such periods the purchase of weaners or gilts is unprofitable owing to the high demand.

Table 19 shows the number of sows compared to the number of milch cows in each zone, and the comparison for 1931-32 and 1932-33.

TABLE 19.

Comparison of Number of Sows to Cows.

Zone.				No. of Cows.	No. of Sows.	No. of Sows to Cows.
1.	Harvey ...	...	...	379	11	1 : 34.5
2.	Bunbury ...	...	...	396	37	1 : 10.7
3.	Margaret River ...	...	...	383	24	1 : 15.9
4.	Bridgetown ...	...	...	179	16	1 : 11.2
5.	Manjimup ...	...	...	222	21	1 : 10.6
7.	Denmark ...	...	...	74	6	1 : 12.3
All Zones, 1933-34 ...				1,633	115	1 : 14.2
,, 1932-33 ...				1,531	144	1 : 10.7
, 1931-32 ...				950	141	1 : 6.7

* Whole milk suppliers excluded.

The very low figures for the number of sows to cows in the Harvey Zone will be noticed. This is explained by the fact that, in this Zone, eight of the 11 competitors were whole milk suppliers, and did not have skim milk available for feeding pigs.

It is estimated that the profit from pigs averages approximately £2 per cow (though this is exceeded by some competitors) where a butter factory is being supplied and this should be borne in mind when assessing the relative cost of producing whole milk for consumption as such, and butter fat for supply to a butter factory.

Experience has shown that for every four to five cows one breeding sow should be carried. It will thus be seen from Table 19 that this avenue of production and revenue is very seriously neglected on the average dairy farm in this State. The last three years has shown conclusively that for farming to be profitable, all possible avenues of production must be exploited—in short the policy of having all one's eggs in the one basket is economically unsound.



9.—Feeding Silage. H. C. Barnsby, Clovelly Farm, Pemberton.

Table 20 shows the breeds of sows owned by competitors for 1932-33 and 1933-34.

TABLE 20.

Breeds of Pigs owned by Competitors.

No. of Sows.		Per cent.		Breed of Sows.
1933-34.	1932-33.	1933-34	1932-33.	
35	70	30	49	... Berkshire
61	55	53	38	... Berkshire and Tamworth
1	6	1	4	... Middle White
2	4	2	3	... Middle White and Berkshire
6	2	5	1	... Large White
10	7	9	5	... Other Breeds
115	144	100	100	

Table 20 shows that the Berkshire and Tamworth-Berkshire sows are still first favourites, no less than 83 per cent. of sows being of this breed.

Recent experiments have shown that, for West Australian conditions, the Tamworth boar mated to a bacon type Berkshire sow will provide a pig suited to both the local trade, and, if for export, a pig that can be fed to a heavier weight and provide a carcass as suitable for overseas markets as any other breed under local conditions.

From the foregoing it will be inferred that increased attention to pig-raising is strongly advocated in conjunction with butter fat production.

SUMMARY.

1. Permanent pasture production is being developed successfully on irrigated farms. On dry farms a number of promising perennial plants are being tested by farmers, *phalaris tuberosa* being the most promising to date.
2. Reliance on conserved fodder is essential on all but irrigated farms.
3. The amount of fodder conserved per cow has increased each year since

the Competition was inaugurated, and in 1933-34 was 1.79 tons of hay, or an increase of 34 per cent. since 1931-32. It is considered, however, that the equivalent of $2\frac{1}{2}$ tons of hay per milch cow is necessary for safety.

4. Interest in the cultivation of green summer fodders must be stimulated in some way, the amount grown per cow being only $1\frac{1}{7}$ th acre. (See Table 12.)



10.—Cow Peas and Maize grown by Mr. S. F. Russell, Serpentine.
Photo. taken 10 weeks after planting.

5. The average production of the 1,633 cows in the Competition was 208.8 lb. of butter fat. (See Table 16.) This confirms the statement made last year that the average cows in the South-West produce approximately 180 lb. of butter fat per lactation period.

6. Fourteen (14) herds, totalling 381 cows, produced more than 250 lb. of butter fat per cow compared with six (6) in 1932-33. (See Table 15.)

7. The use of pure bred bulls for grading-up for production is generally recognised, the percentage in use according to breed being as follows:—

Jersey	...	...	...	...	57
Guernsey	...	...	...	...	18
A.I. Shorthorn	...	...	...	...	15
Ayrshire	...	...	...	...	5
Friesian	...	...	...	...	5
					<hr/>
					100 per cent.

8. The production of butter fat per acre was 43.8 lb., a figure remarkably close to that for the two previous seasons, i.e., 42.6 lb. and 43 lb. (See Table 17.) This figure may be accepted as the expectation for production on average unirrigated land. The six leading competitors, however, produced 48.6 lb. butter fat per acre.

9. The average herd in the Competition contained 26.3 milch cows, the tendency each year being for herds to become larger. (See Table 18.)

10. The average dairy farm comprised 127 acres. (See Table 18.)

11. The area required to carry a milking cow or cow unit has been remarkably constant during the three years, namely, 4.7 acres in 1933-34, 4.7 acres in 1932-33, and 4.9 acres in 1931-32. This figure may be taken as the acreage of average dry land required to maintain a cow unit. (See Table 18.)

12. There is a general lack of attention to avenues of production other than butter fat.

13. Pig-raising has fallen to a dangerously low ebb in that even breeding sows have been disposed of, the number being only one sow to 14.2 cows, or less than half as many as in 1931-32. (See Table 19.)

14. Phosphatic licks are being fed generally, and are essential during the summer months; and, with heavy-producing cows, may be fed all the year round with profit.

SOYA BEAN TRIALS, 1933-34.

H. G. ELLIOTT,

Agricultural Adviser, Dairy Branch.

The soya beans which were obtained through the courtesy of the Ford Motor Company of Australia were the subject of experiments at various centres to determine their possibility as a summer growing legume, as it is necessary for the farmers in Western Australia to obtain a strong growing summer legume to provide a food rich in protein and lime to be used as a supplement with other summer fodders, such as maize, sorghum, elephant grass, etc.

The following table gives the results of the trials for the season 1933-34:—

District.	Rainfall during Growing Period.		Results.
Margaret River ...	500 points	...	Failure; poor germination; no growth.
Muresk ...	1½ inches	...	Germination good; growth good, but spindly, ground moist, but beans shrivelled up in the hot weather.
Denmark ...	580 points	...	Failure; plants spindly.
Munja Station ...	26 inches, December to February	...	Planted 2½ acres. Good season; complete failure. Poor germination; stunted plants; no seed production.

Note.—All seeds were inoculated with the Soya bean bacteria just prior to planting.

From the above table it will be seen that failures resulted, and it is believed that this crop is quite unsuitable in Western Australia, with the exception perhaps of some in the irrigated areas.

Good results, however, have been obtained in this State with the growing of cow peas as a summer growing legume to supplement the necessary protein food required.

LOCALLY DESIGNED EQUIPMENT FOR THE COLLECTION OF MILK SAMPLES FOR BACTERIOLOGICAL EXAMINATION.

H. A. PITTMAN, B.A. (W.A.), B.Sc. Agr. (Hons.) (Sydney).

Plant Pathologist.

Following on the establishment in this State by Act of Parliament in 1932 of the Metropolitan Whole Milk Board, it became necessary for the Board to establish some means of obtaining routine bacterial counts of the milk being supplied by dairymen to the consumers of Perth and its environs, at various points in its route from the producer to the consumer. Moreover, inasmuch as it was intended to demand a high quality in the milk, from the point of view, *inter alia*, of maximum permissible bacterial flora (500,000 per cc.), it was essential to evolve some means of ensuring, in the first instance, that a representative sample of milk should be taken, and that, in the second, no increase in the bacterial numbers should take place in the period elapsing between the taking of the samples and their delivery to the laboratory for examination. The Director of Agriculture (Mr. G. L. Sutton) was approached by the Chairman of the Whole Milk Board (Mr. T. H. Wilson) with the proposal that the examination of samples should be carried out in the Dairy Laboratory of the Department of Agriculture, which was then in process of formation under the control of the writer.

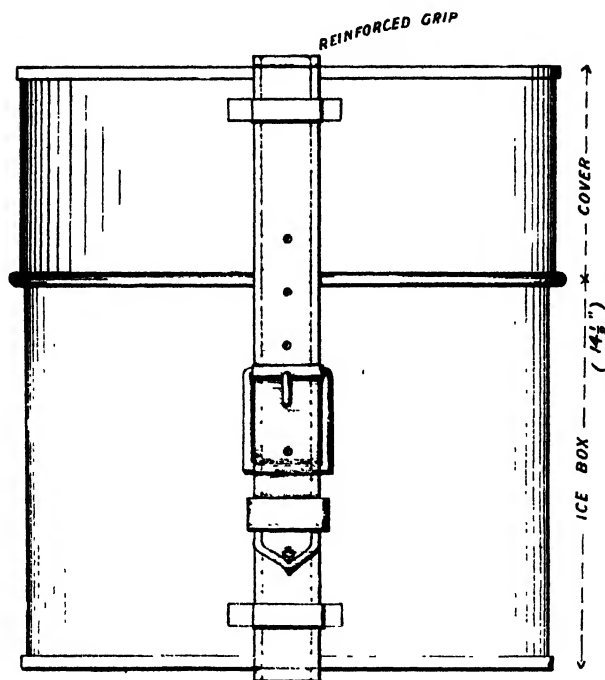
As it was found impossible to purchase suitable equipment ready-made, the apparatus and technique described below was evolved by the writer with the aid of his assistants, Messrs. J. M. Allan, B.Sc. Agr. (Hons.) (W.A.), and H. Kretchmar, B.Sc. (W.A.), A.A.C.I., the valuable help of both of whom is here gratefully acknowledged.

At first samples were taken from, say, 10-gallon cans of milk, by thoroughly agitating the contents with the conventional perforated metal disc stirrers. The samples were then dipped out of the can with a metal dipper and poured into medicine bottles. A sterilised stirrer, sterilised dipper and sterilised bottle were used for each sample taken.

The medicine bottles were soon abandoned for wide-mouthed ground-in glass-stoppered reagent bottles, which were placed in white paper confectionery bags before sterilising in the hot-air oven, and, subsequently, on being unwrapped, each provided with a spring steel clip to prevent any movement between the stopper and its bottle.

Owing to the cumbersome nature of the metal disc stirrers, it was decided to abandon these in favour of Bishop's boiler gauge glasses of two feet six inches in length with a bore of $\frac{5}{16}$ th inch and a thickness in the wall of approximately $\frac{3}{32}$ rd inch, making an overall diameter of approximately $\frac{1}{2}$ inch. These are separately rolled up in paper and placed to the number of fifteen in a specially made, welded, stainless steel cylinder before sterilising.

The paper is carefully folded over at each end of the tubes during the rolling up process, so as to obviate the possibility of particles of dust gaining entrance to the tubes prior to use, in spite of the opening of the metal case containing them. The paper covering is made to be a loose fit, the tube being placed



— ELEVATION —

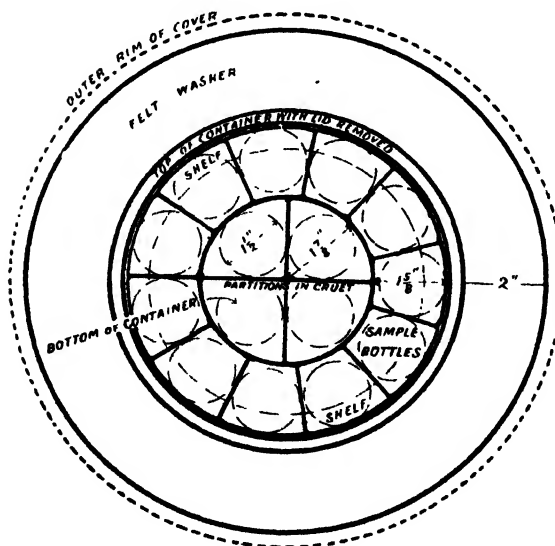
— PLAN OF ICE BOX —
(COVER REMOVED)

Fig. 1.—Showing elevation and plan of ice-box used for transporting milk samples for bacteriological examination.

Drawings by courtesy of Chief Draughtsman, Lands Dept.

diagonally on the oblong sheet of paper used for wrapping it, before being loosely rolled up, and the final corner flap of the paper being fastened in position with a dab of paste.

A loose wad of cotton wool is placed on top of the tubes before they are sterilised in their steel cylinder, to provide a means of preventing violent movement of the remaining tubes when some of their number have been removed for taking samples.

THE TECHNIQUE OF SAMPLING.

When sampling, the spring clip is first removed from the sample bottle and placed on one side. The top of the paper sheath surrounding a glass sampling tube is then broken open and the tube carefully pulled out, care being taken not to touch any part of the tube, with the exception of the upper end. The milk is then thoroughly stirred by vigorous clockwise and counter-clockwise movements of the rod in the milk. A small wad of cotton wool which is inserted into each tube before sterilising prevents any contamination entering the milk in the tube from the operator's thumb, etc.

When the milk has been thoroughly stirred, the tube is withdrawn from the can, allowed to drain for a moment or two, then *slowly* lowered vertically through the milk until it reaches the base of the can. The mouth of the tube is then closed with the thumb and a column of milk is drawn out and carefully allowed to run into the sterilised numbered bottle which has just previously had its stopper removed with the other hand and is waiting to receive it. After the milk has drained out of the tube, the used tube is placed back into its paper sheath (this is not important), and then into a second stainless steel cylinder which is carried by the Inspector for the purpose of receiving the used tubes. These used tubes are protected from breakage by loosely plugging the space between the tubes with cotton wool or a roll of paper. A wad of cotton wool reposes in the bottom of each metal container to prevent breakage of the tubes by sudden contact with the bottom of the metal cylinder.

The spring clip having been placed back on its bottle, which bears a numbered metal tag wired to the neck, the bottle is placed in one of the compartments of the "cruet" section of the ice box. This ice-box (see figs. 1, 2, 3 and 5) holds about 7 lbs. of finely crushed ice which is placed in the ice chamber by the Inspector some time before the first samples are taken, so that the temperature of the interior of the ice-box will have been reduced to about 0°C. when the samples are taken. It has been found that the 7 lbs. of ice will last for about 48 hours in the summer months when the shade temperature may be in the vicinity of 100°F.

As commonly used each ice-box holds 15 one-ounce, wide-mouthed, ground-in glass-stoppered sample bottles, but, by the use of a differently designed "cruet" section, one dozen two-ounce bottles may be carried in each box. Each sampling tube delivers about one ounce of milk from a full 10-gallon can. The metal parts of the ice-box are made entirely of "nickel silver," and the conduction of heat from the bottles to the ice chamber through the metal work is very rapid. The detailed structure of the ice-box and of the metal cylinders for holding the sampling tubes is shown in figs. 1, 2, 3, and 5.

In connection with the sterilising of the equipment used, a special hot-air sterilising oven fitted with automatic thermostat was also designed by the writer in co-operation with Messrs. J. M. Allan, H. Kretchmar and Metters Ltd., Perth.

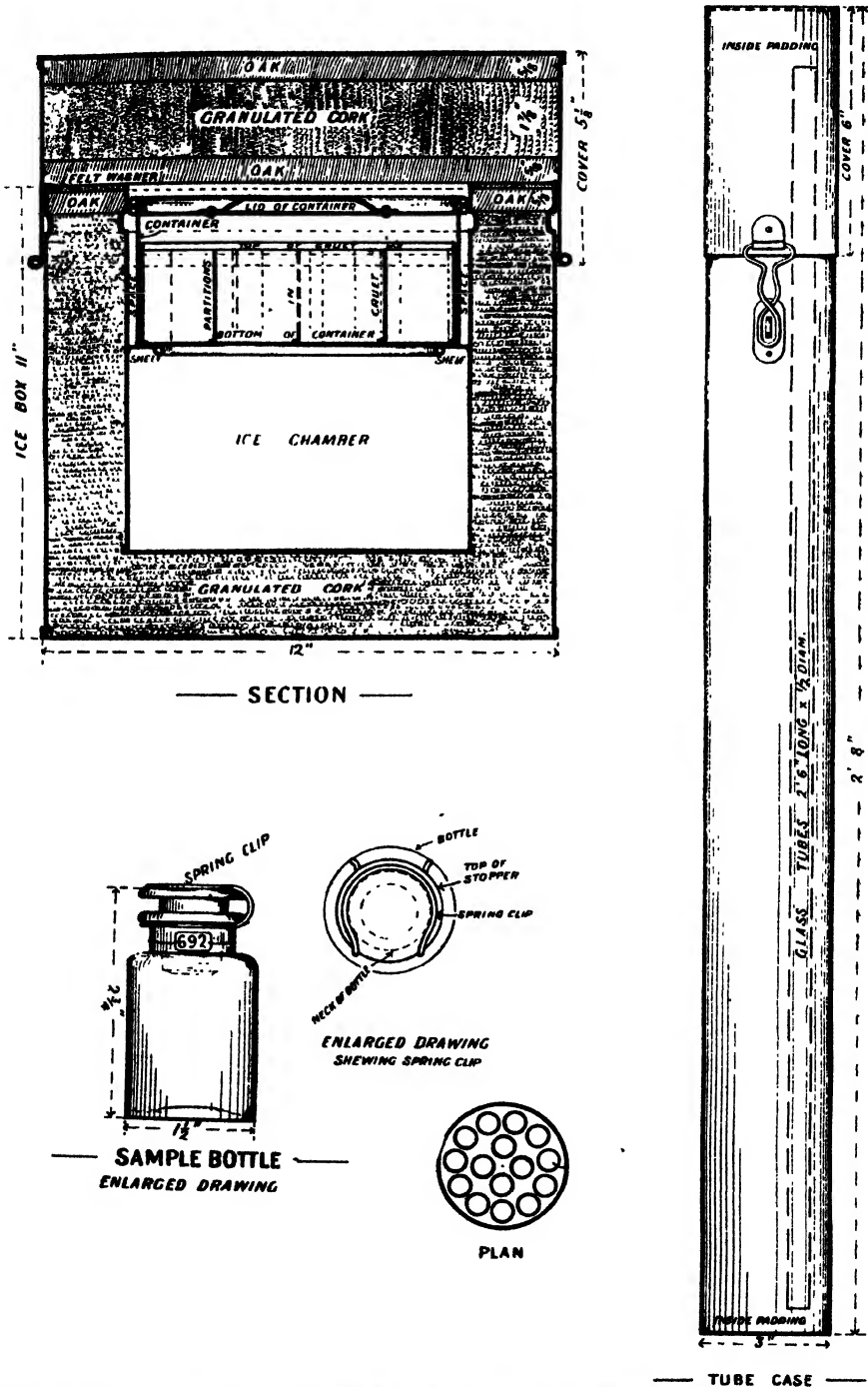


Fig. 2.—Showing section of ice-box, elevation and plan of stainless steel cylinder for carrying glass sampling tubes, and sample bottle with spring clip to prevent movement of ground-in glass stopper.

Drawings by courtesy of Chief Draughtsman, Lands Dept.

It is sufficiently long to hold the metal cylinders, with their contained paper-wrapped boiler tubes, in a horizontal position, with an inch or two to spare at either end. Twelve metal cylinders may comfortably be accommodated at the one time, together with approximately 180 sample bottles (twelve sets), and a large number of 1 c.c. pipettes for use in making the milk smears in the laboratory. The temperature used for sterilising the glass-ware, etc., is 150 deg. C. (302 deg. F.) for 1½ hours, although the oven can be set to run at considerably higher temperatures if required. Automatic control of the temperature is obtained with a "Sperson" thermostat. The oven with the doors closed and open respectively, is pictured in Figs. 4 and 5.

As a result of the use of the apparatus referred to in this article, it has been found quite easy to detect with certainty the dairymen using uncleanly production methods, and subsequent inspections of these dairymen's production techniques, by an officer of the Dairy Branch of the Department of Agriculture, acting under instructions from the Superintendent of Dairying (Mr. G. K. Baron-Hay), have usually resulted in a speedy solution of the cause of the excessively high bacterial counts and consequently marked improvement in keeping quality.

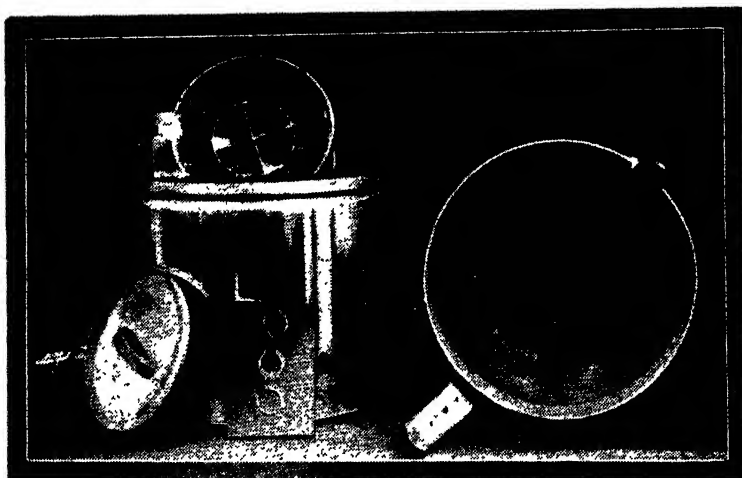


Fig. 3.—Ice-box for transporting milk samples for bacteriological examination, showing lid of ice-box from its under side, the "cruet" in its "cruet" container tilted on its side so as to show the compartments into which the sample bottles are placed, the lid of "cruet" container leaning against left side of ice-box (on which it is throwing a heavy black shadow), one sample bottle standing on the felt washer which makes a compressible seal between ice-box and its lid, and three spring steel wire clips for sample bottles sewn to black card for photographic purposes.

Photo. by Govt. Printer.

BRIEF SPECIFICATIONS OF ICE-BOX.

Overall height, excluding leather straps, 14¼ inches; diameter, 12 inches; height of ice-box without lid, 11 inches; width of felt washer used between ice-box and its lid, 2 inches; thickness, ¾ inch; thickness of granulated cork layer in wall of ice-box and below ice chamber, 2 inches; thickness of silky oak below felt washer, above felt washer and below metal top of ice-box lid, ¾ inch; thickness of granulated cork in ice-box lid, 1¼ inches; total overall depth of lid of ice-box, with overlap, 5½ inches; metal exterior of ice-box lid overlaps ice-box for 2 inches.

Diameter of ice chamber, 7¾ inches; height of ice chamber, 5 inches; width of shelf supporting "cruet," ¾ inch; depth of "cruet," 2½ inches; internal dia-

meter of "cruet," $7\frac{3}{8}$ inches; overall diameter of "cruet," $7\frac{7}{16}$ inches; internal diameter of "cruet" container, $7\frac{1}{2}$ inches; overall diameter, $7\frac{3}{4}$ inches; height of "cruet" container, $3\frac{3}{8}$ inches; space between base of "cruet" container and lower side of its lid, $3\frac{1}{8}$ inches. This allows approximately $\frac{3}{8}$ inch between top of sample bottle and lower side of lid of "cruet" container. Height of "cruet" container lid with handle, $\frac{3}{4}$ inch; height of sample bottle $2\frac{3}{4}$ inches; diameter, $1\frac{1}{2}$ inches. The four central compartments of the "cruet" are $1\frac{7}{8}$ inches inside radial

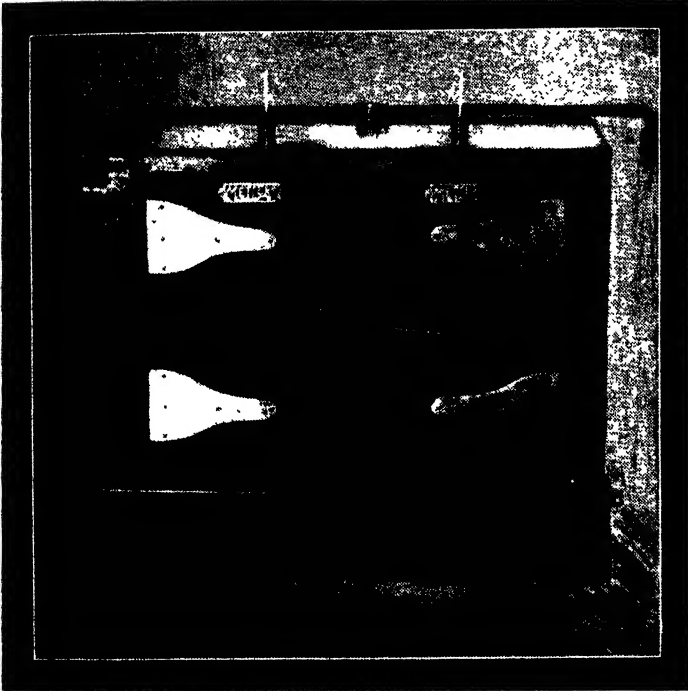


Fig. 4.—Hot-air sterilising oven for sterilising glass sampling tubes in their stainless steel cylinders, sample bottles, milk pipettes, etc., Note the two thermometers inserted through openings in the top of oven, the protruding portion of thermostat near top left-hand side, and flue for controlling air circulation in middle back of top of oven. The oven stands under an exhaust hood which removes the heated air from the room.

Photo. by Gort, Photographer

measurement. The eleven peripheral compartments are $1\frac{3}{8}$ inches in inside radial measurement. Thickness of turned-over metal approximately $\frac{1}{32}$ nd inch, except at centre, where four partitions meet, where it is $\frac{1}{8}$ inch. The "cruet" has no top or bottom of its own, but rests on the bottom of the "cruet" container, in which it is free to move in a circular manner. It is a fairly tight fit in the "cruet" container, but can easily be removed from it. The "cruet" container similarly fits into the central cavity of the icebox rather snugly, but this also can be readily removed so that ice can be placed into the ice chamber, or the water poured out when the ice has melted, etc.

The dimensions of the "cruet" and "cruet" container relative to those of the sample bottles being used are the most important. The rest of the ice-box can be considered as being built up around these two central units. All metal used was

24-gauge nickel silver throughout. The ice-box is carried by means of a stout leather strap with reinforced handle, and a large buckle on each side of the box to allow lid to be removed. The ice-box weighs approximately 22 lbs. without ice or sample bottles, 31½ lbs., approximately, with ice and empty sample bottles, and 32½ lbs., approximately, with ice and full sample bottles.

BRIEF SPECIFICATIONS OF STAINLESS STEEL CYLINDERS.

Overall length, 2 feet 8 inches; overall diameter, 31/16th inches; 20-gauge "Staybrite" stainless steel; lid, 6 inches long; overall diameter, 3 3/16th inches; 20-gauge. Boiler tubes for sampling, Bishop's "Adamant," 2 feet 6 inches long by ½ inch overall diameter by 5/16ths bore; wall, 3/32nds inch thick. The capacity of the Boiler tubes is 15.5c.c.s. per foot of length. Tubes with a bore of ¼ inch were ordered but could not be obtained.

The steel cylinders are now being fitted with steel handles just above the point of balance to facilitate carrying them. The cylinders weigh 4½ lbs. each when empty and 9 lbs. when full of paper-wrapped Boiler tubes.

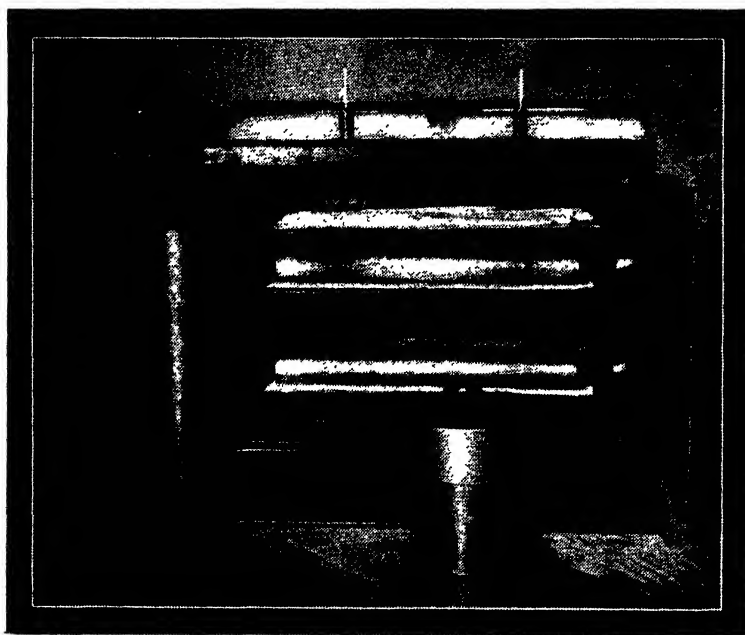


Fig. 5.—Hot-air sterilising oven with doors open, showing the three shelves, the bottom two of which bear several stainless steel cylinders, while the top one carries several sample bottles and a large number of paper-wrapped pipettes. Paper has been placed on the shelves to increase the contrast when taking the photograph. Note stainless steel cylinder standing in front of door on the left and ice-box on laboratory floor in front of oven. The whitish patches on the door on the right are reflections from the cylinders in the oven.

Photo. by Govt. Photographer.

BRIEF SPECIFICATIONS OF HOT AIR STERILIZING OVEN.

Internal length, 3 feet; internal width, 2 feet 1 inch; internal height, 2 feet. Three perforated shelves 6 inches apart, with bottom shelf 6 inches above floor of

oven. Back and doors 1½ inches thick, lagged right through. Inner wall of oven hollow with 1-inch cavity in sides and roof, and 2-inch cavity in floor; lagged below the floor cavity 1½ inches.

Outside the hollow inner wall is a second cavity on sides and roof only, 1½ inches wide. This is surrounded by a wall lagged with slag wool 1½ inches thick. In the outer cavity on each side of the oven is a horizontal tube burner extending the full length of the side of the oven. This is placed level with the floor of the oven.

The waste gases from the burners pass up through the outer cavity of the sides and roof to the flue at the middle back of the oven. This outer cavity in the roof is baffled to ensure even distribution of the heated gases from back to front of oven.

The air in the inner cavity, which has become heated by contact with its hot outer wall, passes to the top of the oven, circulates through a series of perforations along the median zone of the roof into the interior of the oven, and thence through perforations in the median zone of the floor, finally passing back through a row of perforations in the outer wall of the inner cavity to the burners. Air can only enter the inner cavity through perforations situated on each side of the oven in communication with the air below the oven floor.

The overall length of the oven without thermostat is 3 feet 9½ inches, with thermostat 4 feet; overall width is 2 feet 6 inches, and the overall height without stand is 2 feet 7½ inches. The stand is 9 inches high.

The top of the oven overhangs the sides, back and doors to a slight extent.

MAIZE VARIETY TRIAL.

H. G. ELLIOTT.

Agricultural Adviser, Dairy Branch.

Resumé of the results to date of the Maize Variety Trial conducted throughout the South-West during the 1931 season.

In recent years a number of new varieties of maize have been evolved in New South Wales, with a view to producing early growing varieties which will be heavy yielders of green fodder or grain respectively.

It was suggested, therefore, that a variety trial embracing some of the newer varieties compared with the standard variety of "Hickory King" should be instituted.

The object of the trial was as follows:—

1. To determine which variety, if any, gives higher yields of green material per acre than "Hickory King."
2. To determine whether any of these varieties are suitable for the production of grain in Western Australia.

The following nine varieties were considered suitable for trial:—

1. Hickory King—Standard for green fodder in this State.
2. Small Leaming—For green fodder.
3. Fitzroy—For green fodder.
4. Silvermine—For green fodder.
5. Early White Dawn—For grain and early green feed.
6. Funk's Early Yellow Dent—For grain and green fodder.
7. Early Morn—For grain and green fodder.
8. 90-Day (Flint)—For grain and early green fodder.
9. Wellingrove—Green fodder.

Fertiliser.—A number of fertiliser experiments with the growing of maize have been carried out for some years in this State, with the result that the general recommendation for the growing of maize is a mixture of superphosphate, $2\frac{1}{2}$ parts, and sulphate of ammonia, 1 part, which can be obtained in commercial mixtures. This mixture was sown at the rate of 3 cwt. per acre. The cost of the fertiliser was borne equally by Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., and the Department of Agriculture.

There were 16 farmers selected to conduct trials, and each farmer had five varieties with "Hickory King" as "control."

Each variety was sown in triplicate in rows 30 inches apart, the rate of seeding in every case being 25 lb. per acre.

The following Table 1 gives the results of the first series:—

TABLE 1.

		Hickory King.	Silvermine.	Welln-grove.	Fitzroy.	Small Leaming.
S. F. Russell, Serpentine	Tons per acre . . . Percentage Yield	7.570 100	7.810 103	6.835 90	9.275 123	7.320 97
W. Wells, Group 53, Busselton	Tons per acre . . . Percentage Yield	6.140 100	7.230 118	6.160 101	8.208 134	8.122 132
G. Doyle, Margaret River	Tons per acre . . . Percentage Yield	20.32 100	17.41 85	10.27 95	20.07 99	16.25 80
E. Meritt, Group 109, Northcliffe	Tons per acre . . . Percentage Yield	10.25 100	11.80 114	10.14 98	11.67 114	11.83 116
J. A. Baron-Hay, Wag-erup	Tons per acre . . . Percentage Yield	17.875 100	16.600 98	17.875 100	16.860 94	24.314 137

The average production of green material for this series is given in Table 2.

TABLE 2.

Variety.	Tons per Acre.	Percent. Yield.
Hickory King	12.431	100
Silvermine	12.170	98
Welln-grove	10.056	81
Fitzroy	12.217	99
Small Leaming	13.005	109

S. F. Russell, Serpentine.

Planted on 9th December on heavy red clay loam and grown under irrigation. Cow peas were grown in conjunction with the maize. The height of the crop ranged from six feet with the "Small Leaming" to 10 feet with the "Fitzroy" variety. Strong easterly winds caused considerable damage to the crop.

W. Wells, Group 53, Bussetton.

The varieties were grown on a grey clay loam which originally carried marri and jarrah. Planting was carried out early in December.

G. Doyle, Margaret River.

Planted on a red loam running into a fine gravel, and grown under irrigation. This crop was excellent, with the exception of "Small Leaming," which gave the lowest yield.

E. Merritt, Group 109, Northcliffe.

The average height of the crop was eight feet. "Hickory King" and "Wellin-grove" were the earliest to mature, while the "Fitzroy" was the latest maturing variety.

J. A. B. Hay, Wagerup.

Grown under irrigation on a sandy soil, "Small Leaming" was undoubtedly the best yielder of green fodder, and appears to mature about mid-way between "Hickory King" early and "Fitzroy" late.

Table 3 gives the results of the second series:--

TABLE 3.
Green Material.

		Hickory King.	Early White Dawn.	Early Morn.	Funk's Early Yellow Dent.	90 Day (Flint).
P. Gibbs, Vasse	Tons per acre	13 980	13 152	11 116	11 116	10 125
	Percentage Yield	100	94	80	80	73
A. Millar, Forest Grove	Tons per acre	5 890	4 828	4 714	5 064	3 535
	Percentage Yield	100	82	80	86	60
T. Briggs, Byford	Tons per acre	12 257	15 220	16 343	18 900	17 875
	Percentage Yield	100	125	133	154	146
J. A. B. Hay, Wagerup	Tons per acre	17 875	13 530	12 500	10 800	12 000
	Percentage Yield	100	76	69	59	66

The average production of green material and the percentage yield for this series are given in table 4.

TABLE 4.

Variety.	Green Material.	
	Tons per acre.	Percentage Yield.
Hickory King	12.502	100
Early White Dawn	11.701	94
Early Morn	11.193	90
Funk's Early Yellow Dent	11.470	92
90 Day (Flint)	10.884	87

P. Gibbs, Vasse.

Plots were seeded on 15th December, 1933, on chocolate loam which originally carried red gum, jarrah and banksia, and the weights were taken at the cobbing stage on 2nd March.

"Funk's Early Yellow Dent" was slightly later than the others, and "Hickory King" was the most outstanding variety.

A. Millar, Forest Grove.

Planted on 9th and 19th December on a red loam originally timbered with karri and red gum. The light weights obtained per acre were due chiefly to late seeding.

T. Briggs, Byford.

Planted on sandy soil overlying a gravelly clay subsoil. At the latter end of the growing period, irrigation was supplemented. Weights were taken when the main bulk of the plants were fully cobbed.

The average for all trials completed to date is shown in table 5.

TABLE 5.

Variety.	Number of Trials.	Green Material.	
		Tons per acre.	Per cent. Yield.
Hickory King	9	12.462	100
Small Leaming	5	13.605	109
Fitzroy	5	12.217	99
Silvermine	5	12.170	98
Early White Dawn	4	11.701	94
Funk's Early Yellow Dent	4	11.470	92
Early Morn	4	11.193	90
90 Day (Flint)	4	10.884	87
Wellington	5	10.056	81

The experiment indicates that at present no departure from the standard variety, "Hickory King," can be recommended.

The results of weights of green material for those experiments not yet completed, and the yields of seed obtained from all experiments, will be published in the next issue of the Journal.

THE DEVELOPMENT OF THE EARLY TOMATO INDUSTRY AT GERALDTON.

B. R. CARSON,

Geraldton District Tomato Growers' Association.

Invariably when the average person thinks of tomatoes, such thoughts are associated with hot summer days and the refreshing salads and other cooling dishes with which this delicious fruit is associated. Hence, up to a few years ago the city of Melbourne was practically bare of tomatoes during the winter months and this was chiefly due to the fact that none were available, the geographical situation and climatic conditions of Victoria being entirely against the growing of tomatoes during the cold season. Through this reason alone, there has developed in the Geraldton district of Western Australia, a primary industry that is not only unique but also a powerful factor in the lives of many members of the community.

It was found that the very mild winter climate of Geraldton, combined with the class of soil available close to the coast, made an ideal combination for the growing of tomatoes that would ripen in the winter months.

Experimental shipments to the Melbourne market on a very small scale were tried and found moderately successful. Since then the quantity exported has increased by leaps and bounds and the Sydney market has been tried and also found to be successful during a certain period of the winter. From such a small beginning, the export of tomatoes to the Eastern States from Geraldton reached the huge total of 107,000 half cases during the winter of 1933, or about 1,150 tons dead weight of tomatoes—certainly an astonishing figure. Besides this, the Perth market is also supplied with a sufficient quantity of the fruit to meet the demand as well as with peas and beans, which also grow with equal abundance in this most remarkable climate.

It can be readily recognised therefore, that this industry is a wonderful asset in the Geraldton district, providing the means of a livelihood to hundreds of people and being responsible for a big yearly income to the district.

Nevertheless, it must not be imagined for a moment that the tomato-growers of Geraldton have discovered the "El Dorado" of gardening—quite the reverse. To be a successful grower requires the possession of most human virtues, the ability to work, and work hard, a superabundance of tenacity of purpose and a knowledge of agricultural science equal almost to that of a scientist.

The growers have many difficulties to contend with, chief of which are the many diseases that must be constantly fought, sometimes successfully, at others much the reverse.

As the growth of the tomato depends entirely on the natural rainfall, seed beds planted in the late summer months have to be watered by hand, a costly and difficult procedure, especially when the water has to be carted. Because of the winds for which Geraldton is notorious, each paddock has to be bush fenced to protect the plants from the wind as much as possible. Many varieties are grown on stakes which mean more expense and more work. During the whole growing period, all plants must be continuously sprayed and dusted to combat various diseases and this is perhaps the most monotonous and costly procedure of the many that the patient grower must undertake.

Now comes, perhaps, the most amazing part of this particular industry, the transportation of the product from Geraldton to Melbourne and Sydney by rail and steamer.

Commonsense indicates that it would be impossible to transport a ripe tomato from Geraldton nearly 3,000 miles over a period of nine or 10 days, subject it to all varieties of temperature, hot and cold, humid and dry, to knock it about with seven or eight different handlings, and expect it to arrive otherwise than a pulpy mess. The fruit is therefore picked in Geraldton at that particular stage of greenness which the grower considers will ensure it being just ripe when it reaches its destination, after allowing for all the aforementioned contingencies. When one considers that the fruit leaves a comparatively warm climate, is transferred from railway trucks at Fremantle to the 'tween decks of an interstate ship after a railway journey of 300 odd miles, is transported by sea to Melbourne and Sydney and arrives at its destination in a temperature of perhaps 40 or 50 degrees, the successful judgment of the grower is nothing short of miraculous.

But the grower being only human, has not the gift of second sight, so he cannot foresee the climatic changes to which his fruit will be subjected. There are many, varied and inconsistent. No two ships carry the fruit at the same temperature, no two train journeys from Geraldton are the same, thus it occurs that sometimes the fruit arrives in Melbourne quite green, sometimes it is over-ripe and

occasionally it is just semi-ripe. It must be remembered that this fruit is an extremely delicate and perishable product and it cannot be carried in freezing chambers, a peculiarity of tomatoes; therefore, it is palpably plain that the picking, packing and transportation is a feat that requires great judgment and experience. Being packed in jarrah half-bushel cases gives the fruit strong protection from the many rough handlings it receives, the jarrah being cheaper and more efficient than white wood.

On arrival in Melbourne the fruit is cleared, distributed to selling agents at the wholesale fruit markets and sold. The whole time it is under the control of a direct market representative of the Growers' Association from Geraldton, who clears it, fixes the price at which it is to be sold, reports on the condition of the various lines to different growers and is directly responsible to the growers for the marketing of the product.

The fruit is rigidly inspected by the Agricultural Department of Victoria and must conform to the various regulations of that State regarding quality, packing and grading. At certain times much of the fruit has to be completely repacked and high waste is caused through various diseases, grubs, over-ripeness, etc., which always develop after leaving Geraldton—as the grower packs only sound fruit.

During the period this product is on the Melbourne market, from the months of August to early November, it does not now have the monopoly of the market. In active competition are the South Australian glass-house tomatoes. These are grown in the suburbs of Adelaide and are an excellent looking fruit produced at a high expense in glass-houses and have the advantage of being only two days from the selling market. Naturally, because of their good appearance, they command a better price than the West Australian tomato. The Geraldton product, however, has the distinct advantage of being naturally grown—not forced, with the result that its flavour is far superior.

Despite the practice of the buying public in buying any fruit on its appearance, the Geraldton tomato is already causing grave concern to the Adelaide growers and as the standard of quality improves, which it must do eventually, there may be a chance of the South Australian growers holding off the Melbourne market until the Geraldton crop is finished. Notwithstanding the very high cost of marketing the Geraldton product, the South Australian is even higher, hence the worry of the Adelaide growers.

By intensive organising and producing a higher quality product, there may be a chance of the Geraldton tomato becoming even a greater factor in the fruit markets of Melbourne and Sydney, but until that ideal state of perfection in quality is reached, the industry can only slowly develop on its own merits.

Such is the Geraldton tomato industry unadvertised, to many practically unknown, yet it is perhaps the only West Australian industry that is helping continuously to offset the adverse trade balance with the Eastern States.

The industry is worth about £45,000 net return to the growers and quite a large sum of money in freights to the railways and interstate shipping companies, employs many men and supports hundreds of people, contributes large orders to the various case making mills in the South-West, superphosphates, manures, sprays, dusts, machinery and all the incidentals appertaining to tomato gardening and, lastly, produces one of the best flavoured tomatoes grown in Australia.

The most remarkable feature of the whole industry is that about 40 per cent. of the tomatoes grown are thrown away, unfit for marketing, as only the very best quality can be sent away.

It is to be hoped that any assistance the various Government Departments can give to the growers to avoid this huge economic waste and improve the quality of the product generally, will be readily forthcoming as these hardy growers in the north certainly deserve all they receive.

HONEY—A FOOD AND A MEDICINE.

H. WILLOUGHBY LANCE, Apiculturist, Department of Agriculture.

The human body requires a great variety of substances for its growth, maintenance and development. The food required by growing children is much the same for all, but the food necessary for the maintenance and development of the adult may vary, according to the class of work engaged upon.

Certain classes of food are, however, required by humans of all ages, no matter what their occupation may be. One of the most important of these is the hydrocarbon group, and one of the commonest of this group is sugar. Sugar is commonly produced from the ground by growing vegetable matter. The commonest form of sugar known is that produced from the sugar cane, and is to be found in practically every household in Australia. In European countries a large amount of household sugar is manufactured from the sugar beet. Both these sugars, however, are manufactured articles; that is to say, they are not in their natural state; they have been extracted from the cane or beet and gone through certain processes known as refining during which everything that is not plain sugar is removed.

The sugar contained in fruit and honey is just as Nature provides it and is in conjunction with certain acids and mineral salts which the body requires.

Chemically, there are three principal sugars contained in honey:—cane sugar (sucrose), grape sugar (dextrose), and fruit sugar (levulose), the last two together being called "invert sugar"—that in plain words mean that it has been inverted or changed. Cane sugar (sucrose) requires to be changed before it can be used by the human body; invert sugar has been changed and is ready for assimilation by the blood stream almost immediately it has been passed into the stomach. The sugar on our breakfast and tea tables is pure sucrose and must be acted upon by the secretions of the stomach and inverted before it can be passed into the blood stream.

Honey contains less than 2 per cent. of sucrose, and often practically none, and from 75 per cent. to 85 per cent. of invert sugar. It will thus be realised that the sugar in honey requires practically no effort to digest and the human body obtains the full benefit of the carbohydrate food. Carbohydrate foods are classed as fuel foods which supply the body with the energy needed for the various tasks it performs, rather than those whose function it is to build and repair the body. In addition to sugar, honey contains volatile oils which give it its aroma and flavour, and indicate to a large extent the plant from which it has been obtained; also a small amount of mineral matter, including magnesia, iron, calcium, phosphorous, etc. In this respect it differs from white household sugar, from which the mineral substances originally present in the plant juices have been removed by the refining process. Although the amount of these mineral substances in honey is not high,

their presence must not be disregarded, as in many of the present day foods they are entirely lacking.

As mentioned previously, honey contains both dextrose and levulose sugars, and it depends on the proportion of these and their relation to the percentage of water as to whether the honey granulates or crystallises solid, or only becomes thick, or whether a portion is solid and a portion liquid. The dextrose sugar granulates but the levulose does not. When the honey has a solid appearance all through, the levulose or fruit sugar fills in the spaces between the granules and is usually small in proportion; when part is granulated and part liquid, the levulose is greater in proportion.

Any honey that has granulated may be made liquid again by immersing the jar in water and raising it to a temperature not higher than 140deg. F., that is to say, not hotter than one's hand can stand. The jar should not come in contact with the bottom of the vessel containing the hot water, but should stand on a piece of wood placed therein.

The value of honey is the same whether liquid or granulated—it is only a physical change that has taken place.

Another important value of honey is its inability to carry germs of any disease that attack the human frame, being self sterilising. The reason for this is that it is hygroscopic, that is to say, it attracts moisture to itself. All life contains water, even the smallest disease germ contains moisture, and if this is removed, it dies. Any germs, therefore, that may find their way into honey are destroyed by having their moisture taken from them by the honey. This is an important fact, which it is not believed applies to any other food.

Medical testimony in favour of honey is increasing daily. Only two, however, will be quoted:—

Dr. Henry Lindlaker, in his *Vegetarian Cookery Book*, writes:—"Always the natural sugars should be used. Honey is the very best of all and should be given preference when available. Maple and pure cane syrup come next in order, then the brown unrefined cane or beet sugar. The highly refined inorganic sugars, powdered, and loaf sugars should not be used."

He is quite definite as to honey taking first place above golden syrup and brown sugar, and advises people not to use white sugar.

Sir Arbuthnot Lane, a physician on the staff of the Lady Margaret Hospital, London, in a booklet entitled "*Honey for Health*," says that "Honey is a food full of energy and therefore stands high as a producer of stamina and strength. Those who add honey to their daily diet may be assured that they are adding to their capacity to work with hands and brain. If every traveller would ask at his hotel for honey with his porridge or cereal foods, he would be far more fit to tackle the day's work. Honey has practically no waste matter in it. Extracted honey is one of the few foods that is all food, and is easily digested." He further goes on to say, "Where people are below par or depressed, where there is chronic constipation with absorbent poisoning, and in children's ailments, honey is a great panacea."

Trade and national conditions are still stated to be depressed. What a pity we cannot take the good doctor's advice and feed them on honey. However, the next best thing is for each individual to make honey an article of daily diet, which will add vim to his constitution and assist him to look on the bright side of things and not meet trouble halfway. All households should have both granulated and liquid honey on the meal tables; granulated honey as a spread on bread, biscuits,

etc., and liquid for use with porridge, cereal foods, fruit salads, etc., and in the place of sugar in tea, coffee, cocoa, lemonade, and other drinks. To the few persons who maintain that they cannot eat honey, I would say "Take it in your drinks, and I am sure you will benefit thereby."

Another important use of honey is for cookery purposes in the place of sugar. In early days before the introduction of sugar, honey was practically the only method of sweetening known. In many countries to-day it is coming into its own for cooking purposes and is no longer a luxury. The twentieth century homemaker is dressing salads with honey, is flavouring tea fancies and cakes with honey, is baking ham for dinner with honey, and surprising evening guests with tasty honey nut sandwiches and delicious fancy cakes and biscuits made with honey.

In using honey for cooking it must be remembered that good honey contains about 17 per cent. water; therefore in mixing, less water will be required than with sugar; also that a cup of honey is heavier than one of sugar; that a cup of honey weighs 12 ounces and sugar 7 ounces, the weight of the sugar in the cup of honey being $9\frac{1}{2}$ ounces as against 7 ounces in the cup of sugar.

One of the advantages of using honey in cakes is that they will keep moist for a very long period, and in fact are improved by keeping. It may, however, be very difficult to keep honey cakes, especially where there are children, unless they are under lock and key.

There are many kinds of honey in the shops, and a large number of people judge honey by its colour and perhaps mild flavour. This is a great mistake. Honey should not be judged by colour, but by its food value and flavour. The darker honeys have been proved by analysis to have a better food value generally than the lighter ones. Some of them certainly do not have an attractive flavour, but this can also be said of many of the light ones.

It is, however, largely a matter of use, and consumers are advised to accustom themselves to a medium coloured honey of heavy body. Thin honeys contain an excessive amount of water and are liable to ferment.

Summarised, the value of honey may be placed under six headings:—

1. It is the only natural sweetening substance on the market.
2. It has already been changed or digested by the bees, and is almost immediately passed into the blood stream.
3. It is an energy producing food.
4. It contains mineral and other substances, so necessary for the maintenance of health.
5. It cannot carry disease harmful to human beings.
6. Last, but not least, it is pleasant and attractive to the taste.

The value of the regular use of honey as an article of daily diet cannot be over-estimated. In addition to this it has an important value as a medicine. Doctors in Europe and America now recognise this, and use it in their regular practice. It is not used in prescriptions on account of its power to counteract disagreeable flavours, but on account of its healing and soothing qualities. It is a well known cure for colds on the chest, influenza, sore throat, etc., taken with hot milk or lemon.

As a cure for constipation a dessertspoonful in a glass of hot water night and morning will nearly always cure this trouble.

Being antiseptic and drawing, it is a wonderful remedy for boils, carbuncles, septic poisoning, and is used by many doctors in prescriptions for pastes for these diseases, making lancing or cutting unnecessary except in late treatment or very severe cases. A simple paste for this purpose may be made with a dense honey; preferably dark coloured, as this contains more iron and tannic acid; mixed with flour, applied to the place on a piece of lint and covered with oiled silk or jaconet and renewed two or three times a day. This has a powerful drawing action and will cause the rupture or opening of the skin, allowing the pus to drain out, and there will be no scar left. The writer has personal proof of the efficiency of this treatment in the case of severe septic poisoning. Boils are usually relieved in a few days, but carbuncles, being more persistent, may take weeks of treatment.

Similar treatment to the above is excellent for burns and scalds, and is also a cure for piles.

The following is an extract in regard to the use of honey as a cure for toothache:—"It is my honest opinion that no living person knows the therapeutic value of honey. How many persons know that it is a wonder remedy for toothache, even where one is suffering from an abscess! Just take a big swallow in the mouth and hold around the affected tooth for a while. It usually does the trick in a few minutes. I have never known it fail. I have sold numbers of people honey for this specific purpose and everyone of them, without exception, has told me that it worked like a charm." (Emmett Baxter, Philadelphia.)

The writer is not able to prove this statement, being past the stage of toothache, but would like to hear from any person who gives the above a trial.

Honey is also an excellent cure for bee stings, especially if applied as a paste and covered up. For frost bites on ears, fingers, etc., apply honey or honey flour paste and wrap up.

For inflamed and sore eyes, a drop or two of liquid honey put in the eyes several times has been known to bring wonderful results, when all else has failed.

Equal parts of honey and cream mixed together is an excellent cosmetic, softening and beautifying the skin, and is said to be a good remedy for freckles.

A splendid candy for colds, coughs, etc., can be made as follows:—Boil a strong solution of horehound leaves in soft water, strain through muslin, add as much honey as desired, boil until all the water evaporates, pour in shallow vessel, and allow to set.

The apiculturist will be pleased to hear at any time from readers desiring information about honey or bees, or requiring recipes for specific purposes, and also to hear of their experience with the various uses of honey.

RABBIT DESTRUCTION—WINTER OPERATIONS.

A. ARNOLD, Chief Inspector of Rabbits, Department of Agriculture.

There are many vermin boards and settlers throughout the State who have done very good work during recent years in destroying rabbits, and have shown by their efforts that the pest can be kept within manageable limits so long as this good work is maintained.

Poisoning during the summer season is undoubtedly the most economical and efficacious method of keeping the pest in check, but fumigation is also necessary. This is mostly employed during the winter months. Any effort, however, to be successful requires continuous and thorough action; spasmodic effort is of little avail.

Unfortunately one cannot help noting that rabbits are increasing in certain areas, and it also causes grave concern to note the apathy and indifference many settlers and vermin boards display towards the pest in not taking action during the winter months. If efforts are only made during the summer months and nothing done during the winter, a serious position will rapidly develop, the pest definitely increasing. Therefore there is need for very definite action by all concerned, not only for a certain period but throughout the whole of the year.

The winter and spring months constitute the main breeding period for rabbits. Many people are under the erroneous impression that poisoning is of no use when any green feed is available, and cease all operations, thus leaving the pest unmolested to breed up again, and undoing the good work done during the summer.

It should be remembered that most of the damage to crops by rabbits is done whilst the crop is growing and the rabbits are breeding, little or no damage being done in what is usually regarded as the poisoning season, for the simple reason that the crop has been harvested.

It has been proved often enough by those who have tried that rabbits can be poisoned during the winter and spring months, especially after green feed has been available for a few weeks, rabbits in common with all other animals welcoming a change of food.

In addition to poisoning, fumigation of burrows can be carried out, and this method of wholesale destruction is particularly effective during the winter and spring, as not only are the rabbits more likely to be in the burrows, but the ground itself is more retentive of the gases or fumes used.

On fine bright days in winter and spring, burrows should not be fumigated unless the rabbits have been chased into them from the crop and scrub or other cover where they are almost sure to be, especially if the previous night has been wet and rough. Neglect of this precaution causes waste of much time, labour, and material, and leads many settlers to declare that the machine, the material, or fumigation itself as a method of destruction, is non-effective.

On account of the large amount of surface cover, such as scrub, dead timber, hollow logs on some holdings, it is impossible to get all rabbits into the burrows. For this reason poisoning should also be undertaken in conjunction with fumigation, as this will tend to prevent stray rabbits from opening up the warrens. Both fumigation and poisoning should be continued for a few days in order to achieve best results. By this means it is possible to keep rabbits in check.

To be successful, every method should be applied thoroughly and continuously, and if co-operative effort is undertaken on systematic lines good results will accrue.

WILD TURNIP.

(*Brassica tournefortii*.)

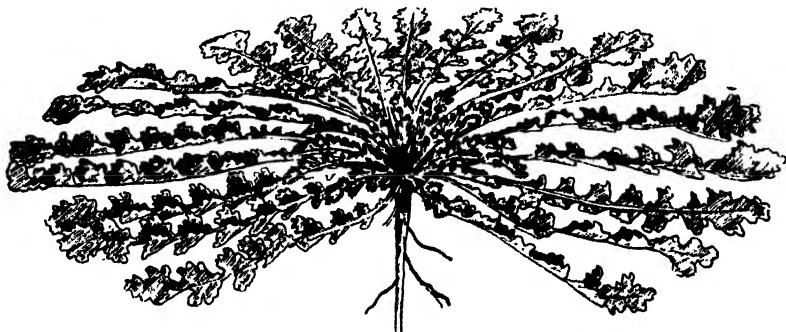
METHODS OF CONTROL.

N. DAVENPORT, Agricultural Adviser.

Now that seeding operations are nearing completion, farmers generally will be concentrating their activities on the preparation of the seed bed for next season's crop and, therefore, the problem of weed-control on the fallow will follow as a natural corollary. In this connection the pasturing of sheep both before and after the land has been fallowed will materially assist, as the sheep will check weed growth and permit of the implements used to deal more effectively with them.

All weeds in a crop are objectionable. There are some, however, which because of peculiar characteristics are particularly objectionable on the wheat farm, and their control is much more essential.

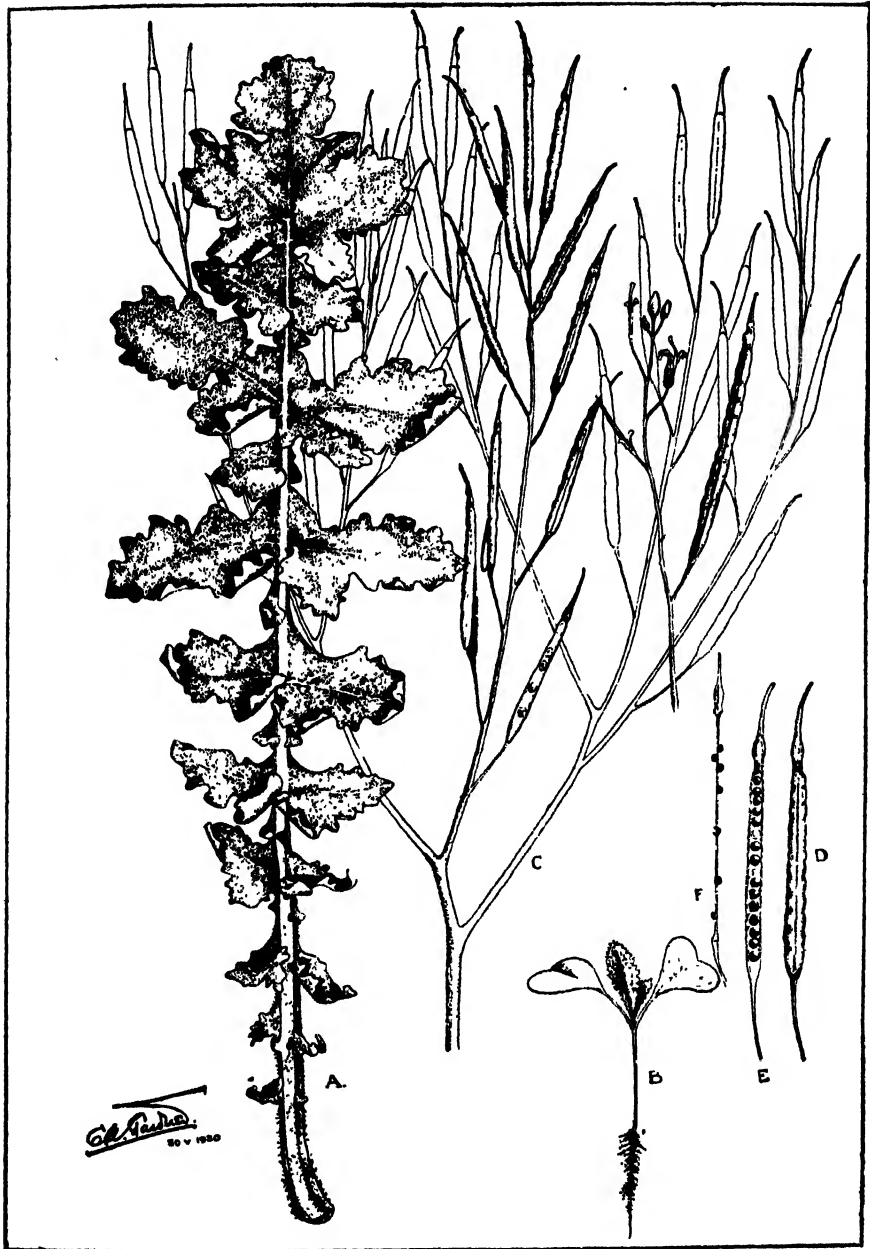
Of these, the wild turnip (*Brassica tournefortii*) is probably the most serious, and during the last few years it has spread to an alarming extent. It is a prolific seeding annual, and many thousands of seeds are produced from a single matured plant. The main stalk of the plant, when mature, is of a pithy nature and very brittle, so much so that the plants are easily broken off at the base and blown along the ground by the wind. In this manner the seeds of a single plant are distributed over a considerable area.



It is imperative, therefore, that every endeavour be made to control this weed. Not only are reduced yields obtained, but harvesting operations are made most difficult.

In common with other weeds, wild turnip is most easily controlled in the early stages of growth, and every effort should be made at eradication before seeds have been formed. This is particularly necessary on land lying in fallow, which will carry the next crop. If only comparatively few plants are permitted to reach maturity thereon, a considerable growth of the weeds will result the following season.

It is recommended that after the land has been fallowed, any young plants making their appearance should be destroyed by cultivation. It is not sufficient to simply run over the land, but the implement should be so adjusted and operated as to ensure that the young plants are uprooted, and where one cultivation is not sufficient, a further cross cultivation should be given. Where the plants are not



EXPLANATION OF PLATE.

A. Leaf (half natural size). B. Young plant, showing primary and secondary leaves. C. Illustrating part of an inflorescence, and the general habit of the summit of the plant when in seed. D. Silique viewed from the side showing the beak and dorsal nerve of one valve. E. Section showing a silique with one valve removed and the seeds in position. F. View showing the ripe silique with the valves removed, the central partition with some of the seeds in situ, and the persistent beak. (Icon. origin.)

This weed has proved such a potential danger to the wheat farmer that it has been gazetted a noxious weed under the "Noxious Weeds Act" over the whole State. In at least one instance the local authority considered it necessary to enforce its power under this Act to quarantine a farmer's holding. This means that before this farmer can remove his produce from his holding he must receive directions as to its disposal. This will indicate to farmers in districts where this weed is not yet prevalent the seriousness of the pest and the importance of preventing its becoming established.

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THE LAMB FOR EXPORT.

Experiments at the Avondale Experiment Farm.

GEO. L. SUTTON, Director of Agriculture.

I. THOMAS, Superintendent of Wheat Farms.

N. DAVENPORT, Senior Agricultural Adviser

With the object of fostering the export lamb industry in order to relieve the depressed condition of the sheep industry and dispose of our surplus sheep, an honorary consultative committee was formed in 1929. This committee consisted of Messrs. E. H. Lefroy, "Cranmore Park," Walebing; W. G. Burges, "Tipperary," York; W. Marwick, York; W. Anderson, Beverley; C. Felstead, Pingelly; I. Thomas (Superintendent of Wheat Farms); H. McCallum (Sheep and Wood Inspector); with Mr. Geo. L. Sutton (Director of Agriculture) as chairman, and Mr. N. Davenport (Agricultural Adviser) as secretary. The function of the committee was to formulate tentative recommendations for the guidance of prospective lamb raisers, and which would be advocated by the Department until more definite information could be obtained from experiments to be carried out.

It was ascertained that the greatest demand on the London market was for a sucker lamb, weighing from 28-36 lbs. A description of the best export lamb may be set out as follows:—The carcass should be compact and symmetrical, and its general appearance light and bright rather than dark or yellowish; it must also be sappy and fresh and not dry, evenly coated with flesh, but not over fat; the fat should be white and well distributed throughout the body, and showing clearly under the tissues, so that the flesh beneath is more or less completely hidden. Particularly must this be the case on the hind-quarters and points of the withers. This covering of fat is technically known as the "selvedge," and gives to the carcass what is known as the "bloom" or "finish." The body should be well rounded with a broad back, full in the buttocks, producing a U-shaped arch rather than the V-shaped lankiness. The shoulders and flanks should also be full, with light bone, thick neck and meat down to the knees and hocks.

It was decided, after exhaustive inquiry and a study of the results of experiments carried out in other parts of the Commonwealth and New Zealand, that, under West Australian conditions, the type of lamb most likely to meet the requirements of the export lamb referred to would be procured by the use of rams of the Dorset Horn, Shropshire, and Southdown breeds, mated with Merino ewes or with half-bred ewes resulting from the mating of British breed Longwool rams with the Merino ewe. The prospective lamb breeders were advised accordingly, but, in order to be in a position to advocate standardised breeding methods as the result of obtaining more definite information under West Australian conditions regarding the relative suitability of the three breeds of rams, Dorset Horn, Shropshire, and Southdown, it was decided to conduct experiments with representative rams of each of these breeds.

It was considered that half-bred ewes of any of the Longwool breeds—Lincoln, Leicester, Romney Marsh or Border Leicester—would be satisfactory mothers for mating with the short-wool rams of the Down type for the production of export lambs. Border Leicester half-bred ewes were, however, used in this experiment as representing the desired type, and because they were available and being bred at the Wongan Hills Departmental Farm. It was decided to conduct the experiments referred to at the Avondale Experiment Farm, the manager of which—Mr. H. J. Bailey—carried out the field work associated with this experiment. Concurrently with the experiments at the Avondale Farm, similar experiments were initiated on the property of Mr. W. G. Burges, "Tipperary," in the York district.

The Avondale Farm is well adapted for stock raising and fattening, and is situated in typical lamb raising country, $4\frac{1}{2}$ miles west of Beverley township, on the Great Southern Railway, and is distant 99 miles by rail from Perth. It is thus within handy rail distance—114 miles—from the W.A. Meat Export Company's works at Robb's Jetty, where the lambs intended for export are treated. The Farm comprises 1,800 acres of undulating and broken country. The soil, as is usual in this district, shows considerable variation from light sandy to red clay loams, the latter predominating.

Seasonal Characteristics.

In normal years the real winter rains commence in May, though it is not unusual for rains to fall in April or, on occasion, even as early as March. These early rains are usually followed by dry weather, but may be sufficient to provide short green picking of natural pasture, and to germinate the seed of fodder crops sown on well-prepared fallow land. It is not usual for natural green pasture to be plentiful until June, but from then onwards until the end of October, natural green feed is abundant. Natural pasture then matures and becomes dry, and during the summer and early autumn no green feed is available. During the late summer, in common with district practice, it is customary to supplement the natural feed with a small ration of conserved food, such as oaten or wheaten hay, oaten grain, and, when available, with silage or a mixture of two or three of these.

Observation during this experiment emphasised that it is essential to provide ample succulent feed for the ewe after lambing, and that, if suitable natural feed is not available, provision for supplementing the shortage should be met by the growth of suitable fodder crops.

In 1931, the first year the experimental lambs were dropped, the natural feed was scarce until late in June, and, in consequence, the usual supplementary

autumn feeding of the ewes was extended later than usual and until the third week in June. On July 25th, the ewes and lambs were turned into a fodder crop of oats planted for the purpose.

The following season—1932—natural feed was not available until June, and from then on was plentiful. In order to provide early grazing prior to the natural feed becoming available—normally in June—a crop of oats and rape was planted in March. The rains in April and May caused the seed to germinate; fair growth resulted and was available for the ewes after they lambed.

In 1933, early natural feed conditions were again poor until late in June. However, a good fall of rain in March, of 199 points, was sufficient to bring along a crop of rape and oats which had been planted and on which ewes, after lambing, were pastured. There was sufficient rain for the fodder crop to make satisfactory growth.

The following table gives the monthly rainfalls at the Farm for the years 1930-33 (inclusive), together with the averages for the seven years ended 1933:—

Year.	Jan.	Feb.	Mar.	Apr.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	..	5	62	153	44	554	610	258	81	35	1,501	..	95	1,906
1931	..	4	43	93	300	172	320	477	325	44	1,638	..	73	1,851
1932	15	..	14	147	553	155	453	416	42	447	2,066	..	37	2,243
1933	30	12	199	27	360	316	198	189	79	143	1,285	..	..	1,553
Av. 7 years	13	22	106	78	255	299	386	270	122	125	1,466	33	29	1,749

THE EXPERIMENTAL FLOCKS.

The half-bred ewes (Border Leicester-Merino) used in the experiment were bred at and obtained from the Wongan Hills Departmental Farm, and the Merino ewes were originally from the North-West pastoral areas, and had been purchased and sent to the Avondale Farm for fattening and sale. The foundation half-bred ewes were four and two toothed, and these were added to each year by more two-tooth ewes from the Wongan Hills Farm.

Both the half-bred and Merino ewes were divided into three equal lots. One lot of each type of ewe was mated with Dorset Horn rams, another lot of each type with Shropshire rams, and the remaining lot of each type with Southdown rams. There were thus three groups of experimental ewes, each containing both half-bred and Merino ewes.

Every ewe in each group was branded with the same identification mark; this was done so as to enable all experimental ewes to be "boxed" after mating and pastured together as one flock, so that identical grazing conditions would obtain for all.

The rams were joined with the ewes at night only, and were separated from them during the day, kept in a small yard and hand fed. After two months the rams were removed and the ewes were run as one flock.

TIME OF MATING.

For the first year the ewes were mated on the 15th December, but, in the following years, it was decided to advance the mating by a month, and, in consequence, in those years the ewes were mated in the middle of November. During the mating period the pasturing arrangements were such that each group of ewes had similar feed throughout. This was achieved by arranging that each group of ewes should be grazed in the same paddocks regularly and in rotation.

The numerical composition of the respective groups is shown in the following table:—

TABLE 1.

Breed of Ram.	Breed of Ewe.	Number of Ewes Mated.		
		1931.	1932.	1933.
Dorset Horn ...	Border Leicester-Merino ...	27	54	90
	Merino ...	27	30	...
Shropshire ...	Border Leicester-Merino ...	27	54	89
	Merino ...	27	30	...
Southdown ...	Border Leicester-Merino ...	27	53	89
	Merino ...	27	30	...
Total all Rams...	Border Leicester-Merino ...	81	161	268
	Merino ...	81	90	...
	Total all Ewes ...	162	251	268

LAMBING DETAILS.

All lambs were weighed at birth, at intervals throughout their growth, and again immediately prior to trucking to the freezing works. A numbered ear tag was inserted at birth and also a body brand corresponding to the group brand of the mother. In this way a complete weight and age history of each lamb was obtained up to the time of slaughter. As the pelt was removed from each lamb on the killing floor, a cardboard tag, bearing the same number as the ear tag, was affixed to the gambrel suspending the carcass, and thus the history was made more complete by being able to ascertain each carcass weight and the grade to which each was allocated. It thus became possible to determine for each lamb, as marketed, its age, birth, weight, farm weight, prior to despatch, carcass weight and the grade of the carcass, as well as its breeding.

In 1931, lambing commenced on May 19th, but did not become general until about June 2nd. In the two following years, as a result of mating the ewes a month earlier, lambing, except in the case of the Shropshire crosses, commenced in both years about April 26th. In the 1933 drop, the Shropshire crosses commenced to drop rather late, and a greater proportion were dropped during June than lambs with the Dorset Horn and Southdown as sires. The lambs were marked when from 10 to 14 days old.

The lambing returns for all crosses for the three years are shown below:—

TABLE 2.—INFLUENCE OF THE RAM ON THE FECUNDITY OF THE EWES.

Particulars of Drop—1931, 1932 and 1933.

Breed of Ram.	Year.	Percentage Lambs marked—		
		Border Leicester-Merino Ewe.	Merino Ewe.	Total all Ewes.
Dorset Horn ...	1931	70	58	63
	1932	50	70	57
	1933	56	...	56
	All years ...	56	63	57
Shropshire ...	1931	37	78	57
	1932	80	80	80
	1933	79	...	79
	All years ...	72	79	74
Southdown ...	1931	22	70	46
	1932	74	73	74
	1933	83	...	83
	All years ...	70	72	71

It is very generally believed that ewes mated with a Dorset Horn ram are more prolific than those mated with a Southdown or Shropshire. This opinion is not confirmed by the results shown in Table 2, which show that there is little difference between the Shropshire and Southdown breeds, and in this instance both show to advantage over the Dorset Horn. The results obtained by Mr. Burges with the experimental flocks at "Tipperary" in 1931 are similar to those obtained at Avondale.

At Tipperary Dorset Horn, Shropshire, and Southdown rams were mated with Longwool-Merino crossbred ewes and also with Merino ewes. The ewes were aged and the crossbreds mainly Lincoln-Merino crosses. The ewes were divided into three flocks each containing 67 crossbreds and 26 Merinos for mating respectively with Dorset Horn, Shropshire, and Southdown rams, two rams to each flock of 93 ewes. Between mating and the commencement of lambing 10 ewes died, and as it was impossible to determine to which of the flocks any of these belonged, it was assumed that three from each flock had died, thus reducing the number of ewes to 90 in each. The results may be seen from the table hereunder:

Breed of Ram.	No. of Lambs from—		Total.	Percentage.
	Crossbred. Ewes.	Merino Ewes.		
Shropshire	51	23	74	82
Southdown	54	18	72	80
Dorset Horn	51	20	71	79

These for experimental purposes are close enough to be regarded as equal. They rather suggest that any difference in the fertility of the ewes is due largely to the individuality of the ram and/or special conditions at the time of mating.

In both these experiments, each breed of ram was mated separately with the ewes. The same comparative results may not be obtained if rams of the three breeds were mixed and working with the ewes in the same paddock.

WEIGHT OF LAMBS AT BIRTH.

All lambs were weighed within three days of birth; this operation was carried out at intervals of three days throughout the lambing period. Thus the age of any lamb at weighing was not greater than three days, with an average of $1\frac{1}{2}$ days.

TABLE 3.—AVERAGE WEIGHT OF LAMBS AT BIRTH.

Breed of Lamb.	1931.	1932.	1933.	Average 3 years.
Dorset Horn x B. Leicester-Merino ...	11.5	10.9	11.2	11.1
Dorset Horn x Merino	8.7	9.6	...	9.2
Shropshire x B. Leicester-Merino	9.5	10.6	10.2	10.1
Shropshire x Merino	8.5	8.9	...	8.7
Southdown x B. Leicester-Merino	9.1	10.7	10.2	10.0
Southdown x Merino	8.1	9.0	...	8.6

These average results confirm the general opinion that the influence of the longwool strain in the mother is to appreciably increase the size of the lamb at birth. When mated with the Merino ewe, the lambs sired by the Dorset Horn rams were $\frac{1}{2}$ lb. heavier than lambs sired by either the Shropshire or Southdown. When mated with the half-bred Longwool ewe the difference in favour of the Dorset Horn was increased to 1lb.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES
BY THE SAME SIRE.

"TIPPERARY," 24th AUGUST, 1931.



Sire—Southdown.

Weights 6th August, 1931: Merino Ewe, 53 lbs.; Crossbred Ewe, 80 lbs.

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES
BY THE SAME SIRE.

"TIPPERARY," 24th AUGUST, 1931.



RATE OF MATURITY.

The comparative average rates of maturity of the lambs produced as the result of mating the Dorset Horn, Shropshire, and Southdown rams with both half-bred and Merino ewes in 1932, and with half-bred ewes only in 1933, are shown in the table hereunder. The results for 1931 have been omitted because it was considered that the varying number of lambs dropped in 1931 for the different crosses did not permit of reliable comparisons being made between the respective breeds:—

TABLE 4.

PERIOD OF MATURITY.

Time taken in days to reach 65 lbs. live weight.

Breed of Lambs.	1932.	1933.
	Days.	Days.
Dorset Horn x B. Leicester-Merino ...	86	84
Dorset Horn x Merino ...	102	...
Shropshire x B. Leicester-Merino	99	90
Shropshire x Merino	120	...
Southdown x B. Leicester-Merino	99	92
Southdown x Merino	121	...

LAMBS FROM MERINO AND LONGWOOL CROSSBRED EWES
BY THE SAME SIRE.

“TIPPERARY,” 24th AUGUST, 1931.



Sire—Dorset Horn.

Weights 6th August, 1931: Merino Ewe, 47 lbs.; Crossbred Ewe, 83 lbs.

It will be seen from this table that the average times taken in 1932 for the lambs from half-bred mothers and sired by Dorset Horn, Shropshire, and Southdown rams to reach 65lbs. live weight, were approximately 86, 99, and 98 days respectively, while for 1933 the corresponding figures were 84, 90, and 92 days. These demonstrate the more rapid growth of the Dorset Horn lambs, which come to hand about a week to a fortnight sooner than those sired by the remaining two breeds. These latter are very similar in their rate of maturity.

It will be seen that the effect of mating the same rams with the Merino ewe, as compared with the Border Leicester-Merino ewe, is to lengthen the period of maturity by about three weeks. It is thus evident that the Merino ewe is not as suitable as the half-bred Longwool ewe for the production of early export lambs.

The results of the experiments carried out by Mr. W. G. Burges at "Tipperary" in 1931 provide additional evidence of the value of both the Dorset Horn ram and the Longwool half-bred ewe for lessening the time necessary to produce lambs of marketable weight. When the first seasonal batch of experimental lambs was being selected for marketing at "Tipperary" on 24th August of that year it was found that, of the progeny of Merino ewes mated respectively with Dorset Horn, Shropshire and Southdown rams, only two lambs—and those by Dorset Horn rams—were of marketable size, whereas 76 lambs from Longwool-Merino ewes, including some from each of the three breeds of rams used, were ready and despatched. The numbers of these and the percentage of the total lambs of each breed are as follow:—

"TIPPERARY" LAMBS, 1931.

Ewe.			Ram.			Number ready for Market.	Percentage.
Longwool-Merino	...	...	Dorset Horn	...	...	37	72.5
Do.	...	...	Southdown	...	...	21	38.8
Do.	...	...	Shropshire	...	...	18	35.2
Merino	...	...	Dorset Horn	...	...	2	10.0
Do.	...	...	Southdown	...	...	} Nil	...
			Shropshire	...	...
			Total	...	...	78	44.3

The relative development of the progeny of the Merino and Longwool cross bred lamb by the same ram may be readily seen from the illustrations herewith.

The records show that at Avondale, with the lambs dropped from the beginning of May onwards it can be expected that, with suitable grazing conditions available, from one-quarter to one-half will be ready for slaughter by the end of July. This being so makes it possible, under similar conditions as obtained at the Avondale Experiment Farm regarding the provision of early grazing crops for the ewes and lambs, for our earliest lambs to arrive on the British market late in August or the beginning of September. This is an advantage which the geographical position of Western Australia gives to the lamb breeders of this State over those of the Eastern States and New Zealand, and it will enable West Australian lambs to arrive on the British market at a period when it is scantily supplied with fresh lambs. It is obvious that this feature should be exploited as far as it is economically possible.

EFFECT OF THE BIRTH WEIGHT UPON PERIOD OF MATURITY.

The effect of the birth weight upon the period of maturity was investigated. For this purpose the recorded birth weights of lambs were divided into three groups: the first group included lambs with birth weights of 6, 7, and 8 lbs.; the

second lambs with birth weights of 9, 10, and 11 lbs.; and the third those with birth weights of 12 and 13 lbs. The average number of days for the lambs in each group to reach a live weight of 65 lbs. was ascertained. These details are shown in Table 5 hereunder:—

TABLE 5.
EFFECT OF BIRTH WEIGHT ON PERIOD OF MATURITY.
(Calculated to 65lb. lamb.)

Group 1 includes lambs with birth weights of 6, 7, and 8 lbs.
" 2 " " " " 9, 10 and 11 lbs.
" 3 " " " " 12 and 13 lbs.

Sire.	Group No.	No. of Lambs.	No. of days to produce 65lb. Lamb.	Weekly Growth Rate.
1932.				
Dorset Horn	1	1	90	4.51
	2	15	88.5	4.35
	3	9	81	4.52
Shropshire	1	4	114.5	3.48
	2	22	100	3.85
	3	10	92	4.00
Southdown	1	4	118	3.39
	2	20	100	3.85
	3	10	90	4.07
1933.				
Dorset Horn	1	3	104	3.88
	2	17	85.5	4.49
	3	23	80.5	4.60
Shropshire	1	9	94	4.31
	2	38	90.5	4.27
	3	19	80	4.62
Southdown	1	8	112	3.57
	2	46	92	4.17
	3	18	81.5	4.53

It is seen that the heavier the birth weight so is the period required to reach maturity lessened. In this connection the results of an experiment carried out at the Chapman Experiment Farm in 1918* are of special interest. In that experiment two lots of in-lamb Merino ewes were fed respectively 1lb. chaffed hay and 3lb. oaten grain. It was found that the average weight of the lambs from the ewes which had the grain ration was 1lb. heavier than that of the lambs from the ewes which were fed on the chaffed hay. It would appear then that, when it is necessary to supplement the natural pasture available for the pregnant ewes with some hand feeding, oat grain should form part of the supplementary ration.

With the exception of the Dorset Horn cross in 1933, the greatest number of lambs fall in the middle group, and some idea of the breed effect on the rate of maturity can be obtained by the rate of maturity of the lambs of each cross in this group.

* Bulletin No. 70—"Sheep Feeding Experiments at the Chapman Experiment Farm," Geo. L. Sutton, 1920.

LIVE AND CARCASS WEIGHTS.

The following table shows the losses between the live weight at the farm and the dressed carcass on the hooks of the abattoirs for the crosses under trial:—

TABLE 6.

EFFECT OF BREED ON PERCENTAGE LOSS ON SLAUGHTER.

Breed of Lamb.	1931.					*1932.					*1933.				
	Average Farm Weight.	Average pre-slaughter Weight.	Average Carcase Weight.	Percentage Loss, Farm to Hooks.	Percentage Loss of pre-slaughter Weight.	Average Farm Weight.	Average Carcase Weight.	Percentage Loss, Farm to Hooks.	Percentage Loss of pre-slaughter Weight.	Average Farm Weight.	Average Carcase Weight.	Percentage Loss, Farm to Hooks.	Percentage Loss of pre-slaughter Weight.	Average Farm Weight.	Average Carcase Weight.
	lbs.	lbs.	lbs.	%	lbs.	lbs.	lbs.	%	lbs.	lbs.	lbs.	%	lbs.	lbs.	%
Dorset Horn x B. Leicester-Merino	70.6	64.2	33.5	52.5	47.8	67.1	34.6	48.4	48.4	63.5	32.2	49.3	49.3	63.5	49.3
Dorset Horn x Merino	62.6	57.1	28.5	54.5	50.1	66.9	32.7	50.8	50.8	...	...	...	...	...	...
Shropshire x B. Leicester-Merino	64.7	59.4	32.2	50.2	45.8	63.5	33.0	48.0	48.0	60.5	31.8	47.4	47.4	60.5	47.4
Shropshire x Merino	60.4	55.7	28.6	52.6	48.7	62.6	31.8	49.2	49.2	...	...	...	...	...	...
Southdown x B. Leicester-Merino	66.0	60.2	31.2	52.7	48.2	63.6	33.9	46.7	46.7	60.9	31.6	48.1	48.1	60.9	48.1
Southdown x Merino	62.5	57.3	31.2	50.1	45.5	63.2	32.7	48.6	48.6	...	...	...	...	...	...

* Pre-slaughter weights not taken in 1932 and 1933.

This table shows that there is a greater loss on slaughter with lambs from Merino ewes than from those from the half-bred ewes; the difference is roughly 2 per cent. in favour of the latter.

When lambs from the half-bred ewes are compared, the respective losses, consequent upon the use of the different breeds of rams, are not great enough to be significant, and there is indeed little difference between the breeds in this regard, the Dorset Horn, however, showing the greatest loss.

The percentage drop has already been dealt with in Table 2. As a corollary to this it is interesting to record the percentage of lambs marketed in relation to the number of lambs dropped, though the former may not be due to inherent characteristics of the particular breed, but may be largely influenced by the management, or by adventitious causes not altogether within the control of the breeder, such as losses due to disease or the depredations of foxes or dingoes. The relation between the lambs dropped and marketed is shown in Table 7.

TABLE 7.

PROPORTION OF LAMBS MARKETED TO LAMBS MARKED.

Breed of Lamb	No. of Lambs Marked.			Lambs Marketed.					
				1931.		1932.		1933.	
	1931.	1932.	1933.	No.	%	No.	%	No.	%
Dorset Horn x B. Leicester-Merino	18	27	50	18	100	26	96	49	98
Dorset Horn x Merino ...	15	21	...	12	80	20	95	...	...
Shropshire x B. Leicester-Merino	10	43	69	10	100	37	86	67	97
Shropshire x Merino ...	21	24	...	18	86	22	92	...	...
Southdown x B. Leicester-Merino	6	39	74	6	100	36	92	72	97
Southdown x Merino ...	19	22	...	17	89	17	77	...	...

The percentages referred to include those obtained from the Merino ewes, and the general tendency shown by the tables for the year 1931 is that a smaller exportable percentage is obtained from these crosses than when the Border Leicester-Merino ewes are used as mothers. This was due to the slower rate at which the lambs from Merinos matured and, in consequence, their lambs had not reached marketable weight when the last draft was sent to the export works. These results emphasise the superior character of the half-bred ewe as a mother of the export lamb.

QUALITY OF THE CARCASSES.

The results of the grading of the carcasses for the duration of the experiment are shown in Tables 8 and 9; in Table 8 numbers are given, and in Table 9 the numbers have been reduced to percentages.

TABLE 8.—QUALITY OF CARCASSES.

Breed of Lamb.	1931.						1932.						1933.						Total, 1931-33.					
	Grades—						Grades—						Grades—						Grades—					
	1st.	2nd.	3rd.	Re- jected.	Total.	No.	1st.	2nd.	3rd.	Re- jected.	Total.	No.	1st.	2nd.	3rd.	Re- jected.	Total.	No.	1st.	2nd.	3rd.	Re- jected.	Total.	No.
Dorset Horn x B. Leicester Merino ewe	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Dorset Horn x Merino ewe	Nil	4	3	1	18	12	12	5	3	2	1	26	16	22	10	1	49	38	37	15	11	3	93	
Shropshire x B. Leicester-Merino ewe	8	2	Nil	Nil	10	26	13	7	1	2	Nil	37	51	11	4	1	67	85	22	6	1	1	114	
Shropshire x Merino ewe	6	7	5	Nil	18	18	13	7	1	1	1	22	5	...	...	...	...	10	14	6	1	1	40
Southdown x B. Leicester-Merino ewe	5	1	Nil	Nil	6	29*	8	6	1	1	Nil	36	53†	13	6	Nil	72	87†	20	7	Nil	Nil	114	
Southdown x Merino ewe	12	4	1	Nil	17	17	8	1	1	1	Nil	17	...	...	...	...	...	20	12	2	2	Nil	34
Total	35	28	17	1	81	106	40	10	10	2	158	120	46	20	2	188	261	114	47	5	5	437	437	

* 22 marked "Swandown."

† 36 marked "Swandown."

‡ 58 marked "Swandown."

TABLE 9.—QUALITY OF CARCASSES.
Expressed in Percentages of Lambs Graded.

Breed of Lamb.	1931.				1932.				1933.				Average 1931-33.			
	Grades---				Grades---				Grades---				Grades---			
	1st.	2nd.	3rd.	Re- jected.	1st.	2nd.	3rd.	Re- jected.	1st.	2nd.	3rd.	Re- jected.	1st.	2nd.	3rd.	Re- jected.
Dorset Horn x B. Leicester Merino ewe	% 21	% 58	% 16	% 5	% 69	% 19	% 8	% 4	% 33	% 45	% 20	% 2	% 61	% 40	% 18	% 3
Dorset Horn x Merino ewe	...	36	64	...	60	25	15	...	38	...	...	...	38	28	34	...
Shropshire x B. Leicester-Merino ewe	80	20	...	...	70	24	6	...	76	16	6	2	75	19	5	1
Shropshire x Merino ewe	33	39	28	...	50	32	4.5	4.5	...	...	...	...	48	35	15	2
Southdown x B. Leicester-Merino ewe	83	17	...	...	*81	17	2	...	+74	18	8	...	+76	18	6	NU
Southdown x Merino ewe	71	23	6	...	47	47	6	...	...	...	...	...	50	35	6	NH
* 58% of total marketed were graded "Swandown." † 50% of total marketed were graded "Swandown." ‡ 51% of total marketed were graded "Swandown."																

* 58% of total marketed were graded "Swandown."

† 50% of total marketed were graded "Swandown."

‡ 51% of total marketed were graded "Swandown."

The main feature of the tables is the decided superiority of the Southdown and Shropshire breeds as producers of first-quality lambs, as compared with the Dorset Horn breed when mated with Border Leicester-Merino half-bred ewes. While the two former appear about equal in this respect, the Southdown in reality shows to advantage, as there is a special demand by the British buyer for lambs of this breed, and, as will be shown later, it was possible in 1932 and 1933 to select choice lines from the first-grade lambs of the Southdown cross and obtain higher rates per lb. for them.

The number of first-grade lambs produced by the Merino ewe is definitely less than the number produced by the half-bred mother. The superiority of the half-bred ewe over the Merino for the production of export lambs is thus again demonstrated. With the Merino ewe as the dam, the Southdown ram produced a greater number of better quality lambs than the Shropshire, and both of these rams a greater number than the Dorset Horn. The grading of the consignment of experimental lambs from "Tipperary," and which have already been referred to in connection with comparative periods of maturity of the respective crosses, also confirm these deductions. The mothers of these lambs were Longwool-Merino cross-breeds, principally Lincoln-Merino. The carcasses by the different rams were graded as follows:—

QUALITY OF "TIPPERARY" LAMBS, 1931.

Quality.	Mark.	Weight.	Sires.		
			Southdown.	Shropshire.	Dorset Horn.
First	Swan	Under 36	17	...	...
Do.	do.	42	4	...	...
Do.	Cygnnet	36	...	11	17
Do.	do.	42	...	5	9
Second	Curlew	36	...	2	7
Do.	do.	42	...	...	3
Third ... ..	... ..	...	...	...	1
Total			21	18	37

Though the best quality of the other crosses were classed as first grade, it was very evident that the Southdown lambs were superior because of their greater plumpness, "primeness" or "finish," and uniformity.

PRICES REALISED IN LONDON.

With the exception of the carcasses in the "rejected" grade, all the lambs from the first year's experiment were forwarded to London. For the two following years only the first and second-grade lambs were sent away, those classed as third-grade being disposed of locally.

Two shipments were sent the first year, the second of which suffered damage by fire while in transit, and its value was assessed by the underwriters.

Consequent upon the demand at higher rates in Great Britain for special quality lambs of the Down type, it was decided to make a special line of the best lambs of the Southdown ram from the Border Leicester-Merino ewes. To these lambs was given the name "Swandown," a name which was considered appropriate for Down lambs coming from Western Australia, the land of the Black Swan. These lambs were specially marked with a label stamped with a black swan and with the name "Swandown" underneath it. The lambs so marked were very favourably commented upon; this was reflected in the price paid for them, which was always higher than that of any other crosses sold on the same day.

The prices realised for the different shipments are given in Table 10 hereunder. The prices quoted for Canterbury lambs on the day of sale are also given for comparison:—

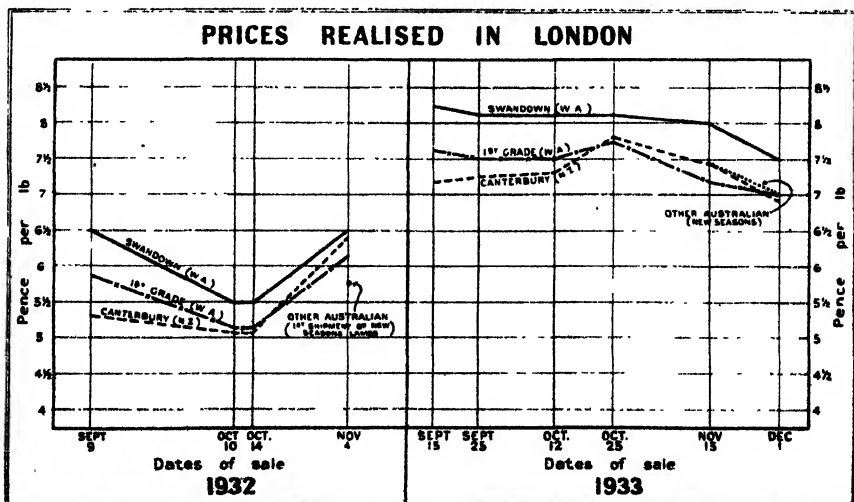
TABLE 10.

PRICES PER LB. REALISED IN LONDON FOR AVONDALE LAMBS.

Shipped per	Date Sold.	Quotations, Canterbury Lambs.	Prices realised, in pence.			
			Swan- down.	1st.	2nd.	3rd.
1931.		d.	d.	d.	d.	d.
Deucalion ...	30th October ...	7½	... {	6½-7½ *7½	} 6½	5½
Cambridge* ...	... ..	...	...	...	...	...
1932.						
Maloja ...	9th September ...	5½-5¾	6½	5½-6	5½	...
Chitral... ..	10th October ...	5-5½	5½	5-5½	4½-5	...
Bendigo ...	14th October ...	5-5½	5½	5-5½	4½-5	...
Cathay ...	4th November ...	6-6¾	6¾	6-6½	5½-6	...
1933.						
Mooltan ...	11-15th September ...	7½-7¾	8½	7½-7¾	7½-7½	...
Chitral ...	22-25th September ...	7½	8½	7½	7½	...
Narkunda ...	9-12th October ...	7½-7¾	8½ ½	7½	7½	...
Strathaird ...	20-25th October ...	7½-7¾	8-8	7½	7½	...
Baradine ...	13-15th November ...	7½-7¾	8	7½-7½	6½	...
Hobson's Bay...	27th November-1st December	6½-7	7½-7½	7	6½-6¾	...

* Cargo damaged by fire. Values assessed at rates of previous shipment.

The comparative prices realised for "Swandown" lambs during 1932 and 1933 are shown in graph form, and are compared with the quotations of Canterbury and "other" Australian lambs sold at that time.



It will be seen from this graph that the prices realised for the special line of lambs sired by the Southdown, and marked "Swandown," have been from $\frac{3}{8}$ d. to $\frac{3}{4}$ d. per lb. higher than our own first-grade lambs, and have even ranged from $\frac{7}{8}$ d. to $1\frac{1}{4}$ d. per lb. higher than the Canterbury lambs. This is extremely gratifying when the good name of these latter on the London market is borne in mind. It must, however, be pointed out that at the beginning of our season our lambs are "fresh," whereas the New Zealand lambs have been in store for some time. Nevertheless, the results obtained have justified the action taken, and demonstrated that lambs of the highest export quality can be produced in Western Australia, if bred in the right way and fed adequately.

The graphs for both years show that the difference in price decreases as the time approaches for the marketing of the New Zealand new season's consignments. It is, therefore, obviously to the benefit of West Australian producers to arrange to market their lambs as early as the climatic conditions will allow, and so take advantage of the fortunate position when the London market is comparatively bare of lambs from our competitors.

SUMMARY.

Experiments were commenced at the Avondale Experiment Farm in 1931, and continued in 1932 and 1933 in order to obtain definite information under West Australian conditions regarding the relative suitability of:—

(1) The Dorset Horn ram;

(2) The Shropshire ram;

(2) The Southdown ram;

when mated with:—

(a) The Longwool half-bred ewe; and

(b) The Merino ewe

for the production of export lambs most suitable for the British market.

The Border Leicester-Merino ewe was used as a type to represent the Longwool half-bred ewe.

The seasonal characteristics are described.

To supplement the natural dry pasture early in the lambing season, fodder crops of oats and rape were grown during the last two years, and ewes, after lambing, were pastured on these.

The experimental flocks mated with each breed of ram consisted of 54 ewes in 1931, 84 in 1932, and 89 in 1933.

Contrary to the popular belief the fecundity of the ewes mated with the Dorset Horn was not greater than that of those mated with the Shropshire or Southdown.

The effect of the Dorset Horn ram was to give a lamb of about 11b. heavier at birth than the Shropshire and Southdown rams when mated with Border Leicester-Merino ewes, and an increase of $\frac{1}{2}$ lb. when mated with Merino ewes.

The weight of lamb at birth influences to some extent the period required for maturity: generally, the heavier the lamb at birth the shorter the time required

The lambs of the half-bred ewes matured about three weeks earlier than those from the Merino ewes mated with the same rams.

The lambs sired by the Dorset Horn ram matured 7 to 14 days earlier than the lambs either by the Shropshire or Southdown.

The lambs by these two latter matured about the same time.

The geographical position of Western Australia makes it possible to produce export lambs to arrive on the London market late in August, when that market is scantily supplied with "fresh" lambs.

There is a greater loss on slaughter, approximately 2 per cent., with lambs from the Merino ewes than those from the half-bred ewes.

When rams of the different breeds were mated with half-bred ewes, the differences in the loss on slaughter of the lambs sired respectively by the Dorset Horn, Shropshire, and Southdown, were not great enough to be significant.



THE "SWANDOWN."

Southdown-Border Leicester-Merino, Tipperary, 1931.

The Shropshire and Southdown rams produce a greater number of first-grade lambs than does the Dorset Horn ram.

From the first-grade lambs sired by the Southdown and from the half-bred ewes, it was possible to select a special line of superior quality to which the name Longwool "Swandown" was given.

The number of first-grade lambs produced by the Merino ewe is definitely less than the number produced by the half-bred mother.

The prices realised for first-grade lambs compared favourably with those obtained for New Zealand Canterbury lambs. Those obtained for the special line "Swandown" exceeded the quotations for Canterbury lambs. The difference was greater with the early lambs than with the later ones.

The returns indicate that our lambs should be marketed early; the extent of the earliness, however, must be governed by the ability to provide ample early feed for the ewes in order that the lambs would be able to receive ample nourishment from birth.

The results of these experiments and the price realised, however, definitely show that export lambs of the highest quality, and which are in the greatest demand on the London market, can be produced by standardised methods in the lamb raising districts of this State.

The results of the experiments show that the standard methods for the production of highest grade export lambs are:—

- (1) The mating of a Longwool-Merino ewe with a Southdown ram as early as natural conditions will economically permit.
- (2) Adequate feeding of the pregnant ewe.
- (3) Ample succulent feed for the ewe after lambing provided, if necessary, by supplementing scanty natural feed by the cultivation of fodder crops.

The outstanding features of the results are:—

- (1) The predominant value of the Southdown ram for the production of export lambs of the highest quality.
- (2) The superiority of the Longwool half-bred ewe over the Merino ewe for the production of fat lambs.
- (3) The value of the Dorset Horn ram for mating with the Longwool half-bred ewe when early maturing lambs are specially required, *e.g.*, the local market.

"THE JOURNAL OF AGRICULTURE"

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GRADE HERD RECORDING, WESTERN AUSTRALIA, 1934.

G. K. BARON-HAY, Superintendent of Dairying.

From time to time during the last ten years requests have been made that Grade Herd Recording should be instituted in Western Australia. Although the value of Grade Herd Recording was fully recognised, after careful consideration it was not thought to be in the best interests of dairy farming generally to introduce such a scheme prematurely.

In 1922 it was realised that a very great expansion of the Dairying Industry was imminent in this State, and it was believed that owing to the rapid increase in the area of pasture, every available dairy cow would be required as a potential dam of dairy heifers.

Graph 1 shows that this belief was sound, as the area of pasture increased from 25,337 acres in 1923 to 430,547 acres in 1933. It will be seen from the graph that the number of cows in the State did not increase in the same ratio.

In order to improve the average production of cows in the State, it was decided that a policy of advocating the use of pure-bred dairy sires ex tested dams would attain the desired result, without reducing the effective number of breeding cows in the State, by culling otherwise unprofitable producers. During these years some 700 dairy sires have been purchased and supplied to dairy farmers on easy terms by the Government.

To assist in this aim a Dairy Cattle Improvement Act was passed in 1924, and the results of this policy for mass herd improvement is shown in Graph 2.

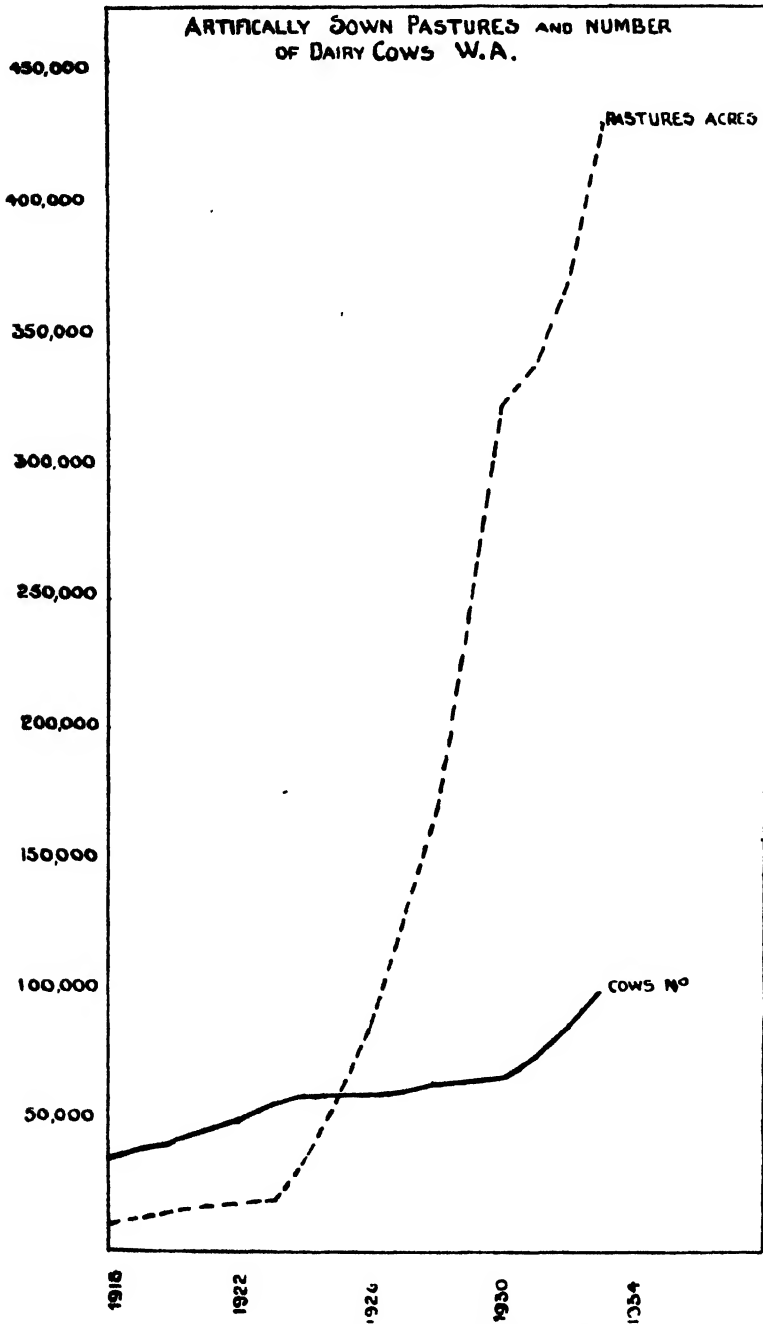
It will be seen that the average production of dairy cows has doubled during the last ten years, coincident with the increase in the use of pure-bred dairy sires, from 23 per cent. to 56 per cent.

During this period of development it was fortunate that the prices of dairy produce remained high (Table 1). However, as soon as these prices commenced to fall, and as dairy farmers had built up the number of their herds during the past ten years, it was believed that the time had arrived when it would be advantageous to institute the recording of grade herds.

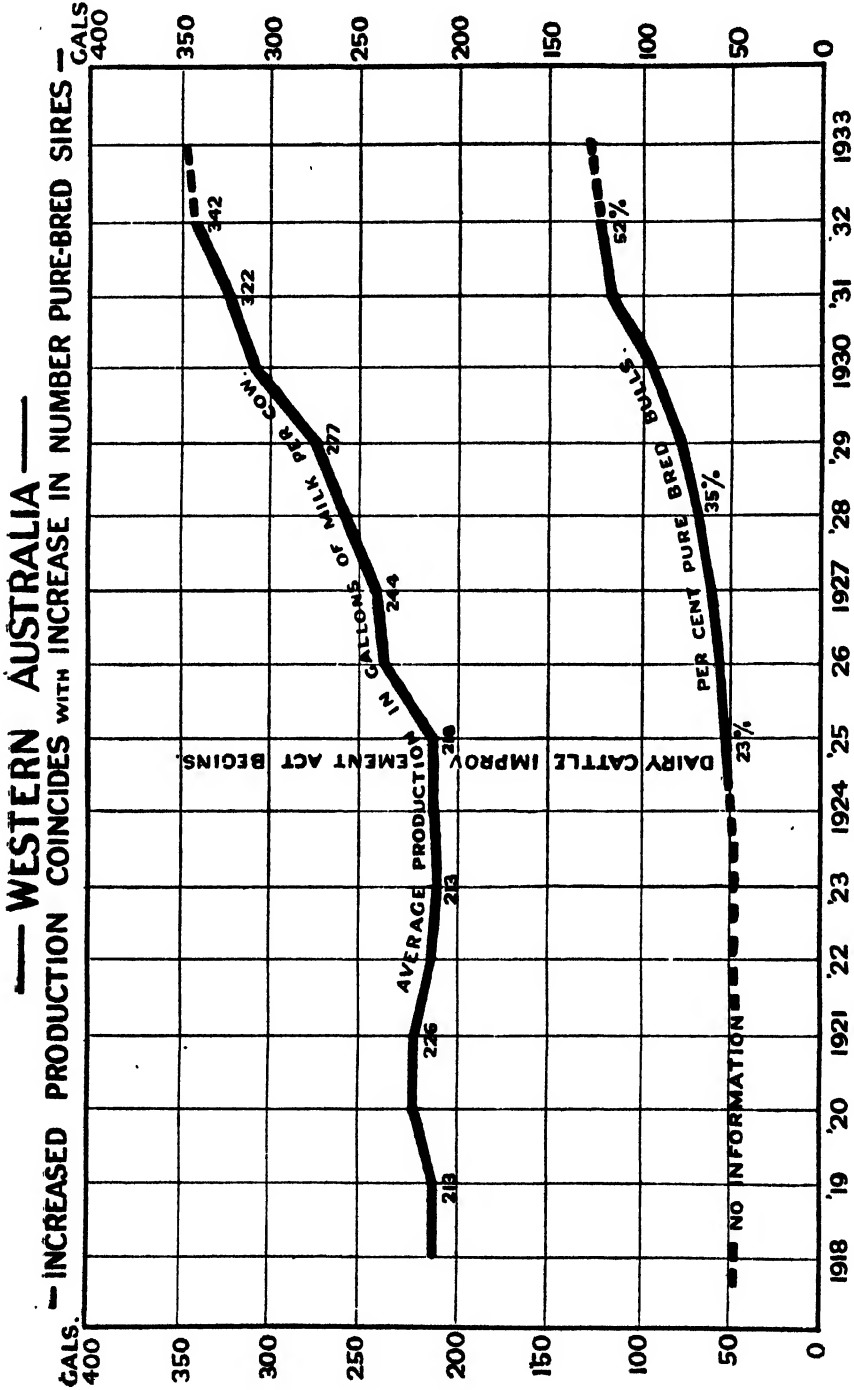
TABLE 1.—PRICE OF BUTTER FAT PER POUND.
1923-1934.

Year.				June.	December.	Average for Year.
				s. d.	s. d.	s. d.
1923	...	...	...	1 0	1 7	1 7½
1924	...	...	...	1 8	1 3	1 6½
1925	...	...	...	1 7	1 3	1 5½
1926	...	...	...	1 10	1 7	1 7½
1927	...	...	...	1 8	1 7	1 8
1928	...	...	...	1 8	1 5	1 7½
1929	...	...	...	1 9	1 7	1 8½
1930	...	...	...	1 7½	1 1½	1 5½
1931	...	...	...	1 3	0 11½	1 3
1932	...	...	...	1 0	0 10	1 0½
1933	...	...	...	0 10½	0 8	0 9½
1934	...	...	...	1 0	...	...

With the assistance of the Rural Credits Branch of the Commonwealth Bank, and the Western Australian Government, the first grade herd recording unit was commenced at Donnybrook in November, 1932, followed by seven other units in May, 1933.



GRAPH 1.—Pasture increased from one-third acre per cow to four acres per cow in 10 years.



During the year ended 31st May, 1934, 159 herds were submitted for test, comprising 4,038 cows, the production of which is shown in Table 2. The average production of each individual herd in the scheme is shown in Tables 10 to 16 at the end of this article.

TABLE 2.—*Average Production of Cows.*

Number of Cows.	Milk, gals.	Average Test, %	Butter Fat, lb.
4,038	415	4.35	180.6

These figures include those for all cows which were under test three months or more, and without any allowance for age.



"GRANTHAM" LADY FOWLER III. (3 years).

Owned by J. A. Scars, Donnybrook. 6,231 lbs. Milk 5.4%
Test, 338 lbs. Fat. in 273 days.

The results may be considered encouraging when compared with those in other States where grade herd recording was initiated, and there is no reason why, provided the information is intelligently used, equally as good results should not be obtained in Western Australia in subsequent years of testing.

The figures for Victoria indicate the progress that can be expected.

TABLE 2.—RESULTS OF GRADE HERD RECORDING IN VICTORIA.

Year.	Number of Cows.	Average Butter Fat Production. lb.
1921	1,600	165
1924-25	7,000	180
1928-29	63,277	222.4
1931-32	89,619	247.3

While the average results during the past year appear encouraging, on examining the productions of cows in each unit, very great differences in yield become apparent, which cannot be attributed solely to the production capacity of the cows. These differences are seen in Table 3.

TABLE 3.—AVERAGE PRODUCTION OF COWS IN EACH UNIT.

Unit.	No. of Herds.	No. of Cows.	Milk.	Test.	Butter Fat.
			lbs.	%	lbs.
A.—Donnybrook	23	446	4,369.00	5.00	219.46
B.—Serpentine	18	372	4,222.50	4.08	172.20
C.—Cookernup	18	509	4,049.51	3.96	160.36
D.—Harvey	20	414	4,190.20	4.45	186.40
E.—Brunswick	21	649	3,810.00	4.44	169.25
F.—Dardanup	21	469	4,088.20	4.61	188.63
G.—Capel	17	814	4,484.98	4.13	182.97
H.—Balingup	21	365	3,862.98	4.52	174.65

It might be inferred that the quality of cows was entirely responsible for the great variation in these average yields, but reports of the Herd Recorders do not substantiate this. A number of factors are known to affect yield, but in every unit it was found that, where herds averaged high yields, it was in great part due to good husbandry practised by the owner in the provision of ample fodder reserves during the summer and early autumn months.

It is significant also that, where whole milk is being sold, it is in these districts generally that yields are low and fodder reserves small. With such a favoured market (butter fat realising 1s. 8d. to 2s. 3½d. per lb.), cows producing low yields of butter fat may be profitable, but in these districts also individual high-producing herds are found. This is exemplified in Table 4, which shows the average production of the three leading herds in each unit and also the average production of the three low-producing herds.

TABLE 4.—PRODUCTION OF THE THREE LEADING HERDS IN EACH UNIT COMPARED WITH THE THREE LOW-PRODUCING HERDS.

Unit.				No. of Cows.	Milk per Cow.	Average Test.	Butter Fat per Cow.
					lbs.	%	lbs.
Donnybrook	1	...	...	44	5,964	5.1	306.2
	2	...	...	45	3,157	4.77	152.6
Serpentine	1	...	...	85	5,591	3.95	221.2
	2	...	...	83	3,854	3.66	141
Cookernup	1	...	...	53	4,830	4.07	196.5
	2	...	...	94	3,583	4.07	146.1
Harvey	1	...	...	102	4,572	4.5	206.5
	2	...	...	123	2,929	4.16	122
Brunswick	1	...	...	83	4,468	4.96	222
	2	...	...	89	2,997	4.47	134
Dardanup	1	...	...	51	5,189	4.93	256
	2	...	...	47	2,730	4.47	122
Capel	1	...	...	121	5,645	4.04	228
	2	...	...	238	3,203	4.12	132
Balingup	1	...	...	58	4,944	4.37	219
	2	...	...	60	2,966	4.17	124

1—Average 3 High-Producing Herds ; 2—Average 3 Low-Producing Herds.

It is believed that the Grade Herd Testing movement will be a means of rapidly spreading the principles of good stock husbandry as practised by the owners of the leading herds in each Unit, particularly conservation of fodder and the pro-

vision of succulent fodder during the summer months. To stimulate this spirit of emulation, a number of cups were offered as trophies to be held by the owner of the highest producing cow in each Unit, and the results show that these high producing cows are not the monopoly of any one Unit.



Herd Testing discovers this type of Cow.

Three gallons at calving; $1\frac{1}{2}$ gallons at 2 months; dry
at 3 months.



Two and a half tons of good hay per milking cow is necessary as an insurance
against scarcity.

DONNYBROOK UNIT.

CUP PRESENTED BY BOYANUP DAIRY COMPANY.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
B. Langridge ... "Lucy" AK6, J. ...	938	6.16	577.6

SERPENTINE UNIT.

CUP PRESENTED BY SERPENTINE CO-OP. CHEESE & BUTTER FACTORY, LTD.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
S. F. Russell ... "Bishop," Gr. A. ...	880	5.01	442

COOKERNUP UNIT.

CUP PRESENTED BY HON. HOBART TUCKEY, M.L.C.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
L. Winduss ... "Tit-Bits," CB 10, A.I.S. ...	932	4.35	405.4

BRUNSWICK UNIT.

CUP PRESENTED BY BROWNE'S, LTD.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
Flannagan Bros. ... "Lily," Gr. J. ...	640	5.84	371

DARDANUP UNIT.

CUP PRESENTED BY HON. LESLIE CRAIG, M.L.C.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
W. Wood ... "Judy 1st," FB 11, Gr. J. ...	772	5.7	442

CAPEL UNIT.

"SUMMERLEA" CUP PRESENTED BY MESSRS. DUNKLEY BROS.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
C. M. Scott ... "Champion," Gr. J. ...	772	4.92	381.2

BALINGUP UNIT.

CUP PRESENTED BY MANJIMUP DAIRY PRODUCE COMPANY, LTD.

	Milk.	Average Test.	Butter Fat.
	gals.	%	lb.
S. C. Maidment ... "Buttercup," Gr. J. ...	849	4.86	413.1

A = Ayrshire ; J = Jersey ; G = Guernsey ; A.I.S. = Australian Illawarra Shorthorn ;
R.P. = Red Poll ; Gr. = Grade.

Apart from the educational value of testing, Table 4 indicates that great improvement in average productions of herds may be effected by systematic and intelligent culling. However, before any farmer can commence to cull his herd, it is essential for a number of facts to be known and appreciated, such as the average production of the herd, the individual production of each cow, the allowance to be made for a heifer in comparison with a mature cow, and all other facts regarding feeding. Table 5 below will give some information on these subjects.



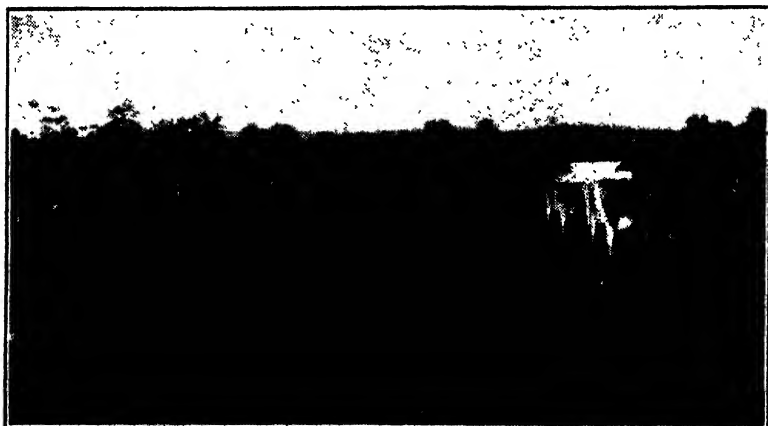
1. Boyanup Dairy Coy. Cup—Won by Barton Langridge, Donnybrook.
2. Donated by Hon. Leslie Craig, M.L.C.—Won by W. Wood, Dardanup.
3. Serpentine Falls Cheese Factory Cup—Won by S. F. Russell, Serpentine.
4. Summerlea Cup (Dunkley Bros.)—Won by C. M. Scott, Elgin.
5. Donated by Hon. H. Tuckey, M.L.C.—Won by L. Winduss, Cookernup.
6. Manjimup Dairy Coy. Cup—Won by S. C. Maidment, Balingup.
7. Browne's, Ltd. Cup—Won by Flannagan Bros., Brunswick.

TABLE 5.—HERDS GROUPED ACCORDING TO PRODUCTION.

Herds Tested less than 273 days omitted.

Unit.	No. of Herds.	Pounds of Butter Fat per Herd.				
		300-350.	250-300.	200-250.	150-200.	100-150.
Donnybrook ...	23	2	5	6	9	1
Serpentine ...	18	...	...	4	12	2
Cookernup ...	18	...	...	1	11	6
Harvey ...	18	...	...	1	12	5
Brunswick ...	21	...	...	4	10	7
Dardanup ...	17	...	1	5	9	2
Balingup ...	17	...	...	5	9	3
Capel ...	21	...	...	5	10	6
Totals ...	153	2	6	31	82	32
Per cent. ...	...	1.31	3.93	20.3	53.55	20.91

As would be expected from the different unit averages for production, the distribution of herds in each unit, according to production, varies greatly, as is clearly shown in Table 5.



Small paddocks, permanent pasture and adequate fertilisation necessary for maximum returns on irrigation areas.

It will be seen that the Donnybrook unit embraced the only two herds to exceed 300 lb. butter fat per cow, and this unit has the distinction of containing the three highest producing herds in the Herd Recording Scheme, namely:—

Owner.	Breed.	Number of Cows.	Average Butter Fat. lb.
J. A. Sears	Jersey	8	320.51
H. Noon	do.	20	310.6
A. Trigwell	do.	16	293.7

Dardanup, which is another well established dairying district, was the only other unit to embrace a herd with a higher average production than 250 lb. butter fat per cow. This also was a Jersey herd owned by Mr. C. Richards, whose 15 cows averaged 284.6 lb. butter fat.

Table 5 shows that no less than 21 per cent. of the herds under test averaged less than 150 lb. butter fat, which at ruling rates for butter fat, are definitely unprofitable. Approximately 54 per cent. of the herds tested appear in the 150-200 lb. group, and it is believed that by culling a number of very low producers in this group and by careful attention to feeding, the majority of these herds can be lifted immediately into the 200-250 lb. group which is believed to be profitable.

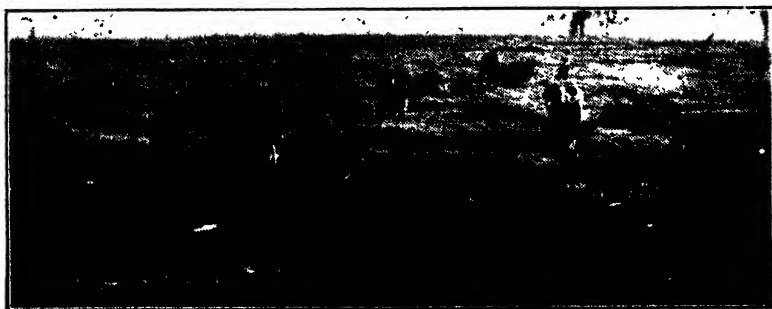
The influence of feeding and management on production is shown in the following extract from the annual report by the Herd Recorder, Mr. R. A. Paul, at Dardanup.

"The unit could be divided conveniently into farms according to the type of country on which they are situated, namely:—

- "1. Clay loam plain country in and around Dardanup, almost entirely devoted to dairying with its adjuncts.

- "2. Sandy loam overlying clay on plain country from Crooked Brook to Boyanup.
- "3. Hilly country east of Dardanup, farms containing small areas of rich alluvial flats and also hilly grazing land. These farms combined beef production with dairying.

"It is interesting to note that all the leading herds are found on the first type of land. Of the 10 herds, six averaged over 200 lb. butter fat, and one averaged 284 lb. butter fat. The owner, Mr. C. Richards, is to be congratulated on this very fine average.



A cheap means of gathering green material for silage on Mr. T. Flynn's property, Ferguson. A trace chain is used as a loop around each heap of material

"The standard of stock husbandry is good, feed being provided throughout the year consisting of hay, silage, cow peas, and maize.

"The four cows which yielded over 400 lb. butter fat are also found in this area.

On the second type of land, stock generally were brought into lactation early in May. Where this was not successful, cows received no particular attention during the summer and, generally, were dried off during January.

On four of the five farms, no early or summer feed was grown and little hand-feeding carried out.

The five herds, containing 132 cows, averaged 177 lb. butter fat, though one herd where hand-feeding was practised averaged over 200 lb. butter fat.

In the third area the averages were lower, probably due to the dual purpose stock out-numbering those of pure dairy type.

The pasture has a short life, and no early feed was provided for cows and little attention paid to conservation of fodder.

The six herds, numbering 136 cows, in this area averaged 148 lb. butter fat. One herd of 32 cows, however, where clover silage, maize, and cow peas were available, averaged 174 lb., the majority of the cows only having been tested seven months.

Here again, it will be seen that the conservation of fodder, besides the quality of stock, is the keynote to high production.

It will be seen that, in order to cull intelligently, each farmer must have a definite objective which will vary according to the individual production of his herd. It is quite obvious that the system of culling in herds averaging 150-200 lb.

butter fat would be totally different from that where the average production ranges from 250-300 lb. butter fat. It is essential, therefore, to ascertain where the unprofitable cows are to be found. Are they to be found in the lower producing herds, or are they more or less distributed throughout all herds—both high producing and low?



Silage being drawn to stacks on Mr. T. Flynn's property, Ferguson, by horses and chain-loops.

A further dissection of the information available is shown in Table 6 where individual cows are grouped according to production from 100-500 lb. butter fat per cow.

TABLE 6.—COWS IN EACH UNIT GROUPED ACCORDING TO PRODUCTION.

Cows under Test less than 100 days not included.

Unit.	Average Butter Fat Production per Cow.							
	No. of Cows.	Over lbs.	400-500 lbs.	300-400 lbs.	200-300 lbs.	150-200 lbs.	100-50 lbs.	Under 100lbs.
Donnybrook ...	454	2	9	46	174	134	71	18
Serpentine ...	372	...	1	10	121	128	83	29
Cookernup ...	512	...	1	5	84	149	153	120
Harvey ...	432	...	2	15	132	131	106	46
Brunswick ...	649	...	...	19	179	182	172	97
Dardanup ...	391	...	4	29	130	121	91	16
Capel ...	814	...	...	37	264	207	279	27
Balingup ...	365	...	1	5	120	126	99	14
Totals ...	3,989	2	18	166	1,204	1,178	1,054	367
Percentage ...	...	·05	·45	4·15	30·19	29·54	26·42	9·20

The comparative rarity of cows exceeding 300 lb. butter fat, namely, approximately 4½ per cent., is most striking and indicates the great improvement that may

be expected from the use of pure bred sires ex cows which have exceeded the official standard under the Pure Breeds Herd Recording Scheme, namely, 350 lb. butter fat per cow.

As an indication that low producing cows are distributed throughout all herds, it will be seen that the percentage of cows producing less than 150 lb. butter fat (35 per cent.) is considerably greater than that of herds averaging this amount (21 per cent.). This is more clearly indicated in Table 7 where three herds are taken at random and unprofitable cows culled from the herds. In two instances, namely, herds 1 and 3, it will be seen that the productions were reasonably high for the whole herd, but after the percentage of definitely unprofitable or "boarder" cows has been eliminated, the remaining herd is undoubtedly profitable.

TABLE 7.—EXAMPLES OF "CULLING" TO RAISE AVERAGE PRODUCTION OF THE HERD.

—			No. of	Average Butter	—	
			Cows.	Fat per Cow.		
				lbs.		
1.—A Cookernup Herd	...	...	31	219	A profitable herd.*	
Culled ...	...	...	8	163	Unprofitable cows.	
Remainder	...	...	23	238		
2.—A Donnybrook Herd	...	...	20	174.8	Unprofitable herd.	
Culled ...	...	...	5	104.4	"Boarder" cows.	
Remainder	...	...	15	198.2	Profitable.	
3.—A Brunswick Herd	...	...	32	195	"Border Line" herd.	
Culled ...	...	...	8	136	Unprofitable cows.	
Remainder	...	...	24	215	Now a profitable herd.	

* With butter fat at 1/- per lb., it is assumed that a cow must produce 200lbs. of butter fat to be profitable.



B.F. II. "Darkie," a grade Hereford owned by S. F. Russell. Serpentine. Production 8,737 lbs Milk, 309.3 lbs. Butter Fat, in 240 days.

Further information regarding the production of cows tested is obtained when the cows are grouped according to age classes. This has been done in Table 8, cows being grouped under the headings of Mature (those exceeding 3 years), 3-year old, Senior 2-year old (over 2½ years at calving), and Junior 2-year old (under 2½ years at calving).

It will be seen that only two cows produced over 500 lb. butter fat—both being owned by Mr. B. Langridge in the Donnybrook Herd Recording Association. "Lucy," a pure-bred Jersey, was the highest producing cow for the year in all Units, producing 577.6 lb. butter fat. The second cow, "Precious," also a pure-bred Jersey, produced 520.1 lb. butter fat in 9 months.



"Lucy," highest producing cow in Donnybrook unit and in Grade Herd Recording Scheme, 1933-34. Owned by Barton Langridge, Donnybrook. Production 938 gallons Milk, 577.6 lbs. Fat, in 273 days. (Photo taken after completing test.)

TABLE 8.—COWS GROUPED ACCORDING TO AGE AND PRODUCTION.

All Cows in Milk less than 100 days are excluded.

Age Class.*	Groups according to Butter Fat Production.							Total No. of Cows.
	Over 500 lbs.	400-500 lbs.	300-400 lbs.	200-300 lbs.	150-200 lbs.	100-150 lbs.	Under 100 lbs.	
Mature	2	16	149	959	737	459	179	2,501
Three years ... ..	...	2	13	158	237	206	88	704
Senior 2 years old ...	...	...	4	32	71	80	33	220
Junior 2 years old...	...	...	1	65	151	297	89	603
Totals	2	18	167	1,214	1,196	1,042	389	4,028

* Age at commencement of Lactation.

When "culling" it is necessary for farmers to make due allowance for age. For practical purposes for cows under 3 years of age, the production should be multiplied by 1.5 to give a yield comparable with that of the cow when mature. Under 4 years of age, the factor is 1.14, while for cows of 4 years and over, the yield as shown by the Herd Recorder can be accepted.

After making due allowance for age, it is interesting to note the varying percentages of cows in the different age classes which exceed 200 lb. butter fat per cow:—

45 per cent. of mature cows tested exceed 200 lb. butter fat.

61 per cent. of 3-year old cows tested exceed 200 lb. butter fat.

78 per cent. of junior 2-year old cows tested exceed 200 lb. butter fat.

This indicates that the younger cows in herds are of higher production capacity on the average than the older cows, which points to a sound policy of breeding being adopted by farmers generally, as mentioned at the beginning of this article



"White Rock" Jerseys, owned by Mr. W. S. Partridge, Brunswick. The result of a consistent policy of "grading up" with pure bred bulls over a number of years. This herd of 48 cows averaged 216.5 lbs. of butter fat in 273 days, without allowances for age.

Table 9 shows the percentage of pure-bred bulls in use in each Unit dissected according to breed, the average percentage of pure-bred bulls in use throughout all herds being 69.7 per cent., which is 14.7 per cent. above the average for the State.

In the butter fat producing districts, the Jersey predominates, 36 per cent of all bulls being of this breed.

In milk producing districts, the Illawarra Shorthorn bull predominates, being 22 per cent. of the total pure-bred bulls.

TABLE 9.—PERCENTAGE PURE BRED BULLS IN EACH UNIT, ACCORDING TO BREED.

Unit.	No. of Herds.	Per cent. P.B. Bulls.	Jersey.	Guernsey.	A.I.S.	Friesian.	Ayrshire.	Red Poll.
Donnybrook ...	23	65.2	56.5	4.34	4.3	...	...	...
Serpentine ...	19	78.9	15.8	...	26.3	21.1	15.8	...
Cookernup ...	23	73.9	4.3	4.34	47.8	13.0	...	4.34
Harvey ...	20	65.0	35.0	...	20.0	5.0	5.0	...
Brunswick ...	21	66.7	42.8	...	23.8	...	...	...
Dardanup ...	21	76.2	57.1	4.76	9.5	...	...	4.76
Capel ...	17	94.1	35.3	...	47.1	5.9	5.9	...
Balingup ...	21	42.8	42.8	...	...	...	...	...
Total Percentage	165	69.7	36.4	1.8	21.8	5.4	3.0	1.2

It is confidently expected that an average yield of 200 lb. of butter fat per cow can be achieved by the end of the second year's testing period, provided cows that are obviously unprofitable be culled, and that efficient methods of husbandry, embracing particularly adequate fodder conservation, are practised.

Table 10-17 give the average productions of each herd in each Unit, the first three herds only being identified, other herds being represented by a code letter, known only to the owner.

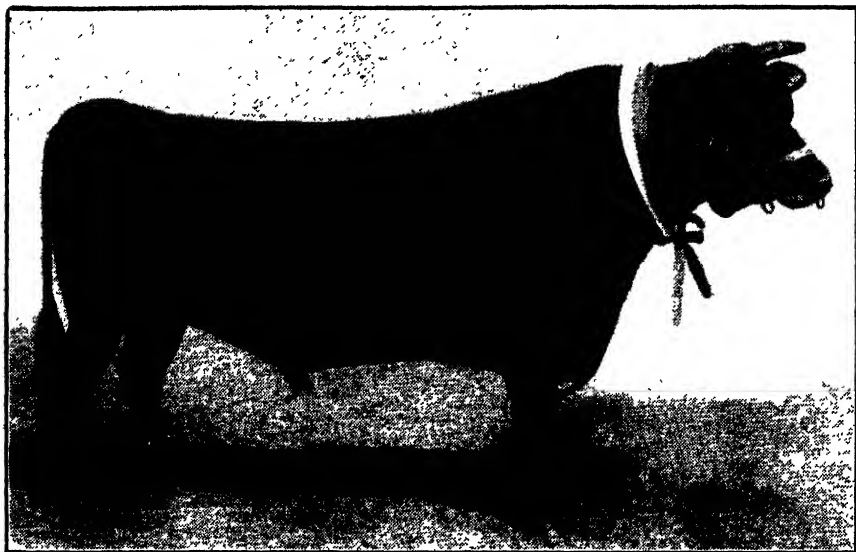
Table 18 gives the names of owners of the three leading herds in each Unit.

TABLE 10.—DONNYBROOK (UNIT "A"). RECORDER P. T. WYLIE.

Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.	%		lb.	
J. A. Sears	8	5,974	5.3		320.51	
H. Noon	20	5,949	5.2		310.60	
A. Trigwell	16	5,970	4.8		293.71	
Herd "C"	10	5,729	5.0		287.12	
" "H"	21	5,167	5.2		273.71	
" "G"	17	4,624	5.5		257.22	
" "K"	21	4,645	5.5		254.74	
" "O"	18	4,486	5.3		237.82	
" "N"	10	4,379	5.3		232.52	
" "E"	25	4,600	4.9		220.26	
" "J"	40	4,534	4.7		216.16	
" "L"	14	3,995	5.3		210.80	
" "R"	16	4,212	4.8		203.00	
" "M"	17	3,879	5.3		199.48	
" "D"	26	4,167	4.7		199.02	
" "A"	31	4,263	4.9		198.83	
" "Q"	20	3,950	4.4		174.82	
" "U"	43	4,637	4.7		173.27	
" "W"	10	3,665	5.4		165.13	
" "F"	24	3,191	5.0		160.91	
" "B"	13	3,229	4.8		156.22	
" "I"	17	3,177	4.8		155.09	
" "P"	15	3,069	4.7		146.80	

TABLE 11.—SERPENTINE (UNIT "B"). RECORDER R. POWELL.

Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.	%		lb.	
S. F. Russell	36	5,631	4.09		230.45	
Geo. Bett	22	6,129	3.57		219.02	
A. H. G. Heath	27	5,099	4.13		210.63	
Herd "Q"	28	5,141	3.95		203.31	
" "H"	21	4,012	4.89		196.30	
" "G"	17	4,248	4.23		179.93	
" "D"	23	3,671	4.75		174.30	
" "X"	8	3,818	4.47		170.81	
" "B"	27	4,093	4.13		169.08	
" "V"	17	4,199	3.91		164.24	
" "J"	9	3,890	4.02		156.39	
" "P"	38	3,932	3.91		153.65	
" "I"	10	3,733	4.06		151.62	
" "U"	21	4,122	3.66		151.15	
" "T"	52	4,351	3.45		150.20	
" "K"	16	3,326	4.47		148.93	
" "E"	15	2,692	3.74		100.75	
" "W"	15	3,213	4.11		91.05	
" "A"	19	2,107	3.71		78.20	



"WERRIBEE" STARBRIGHTS KING.

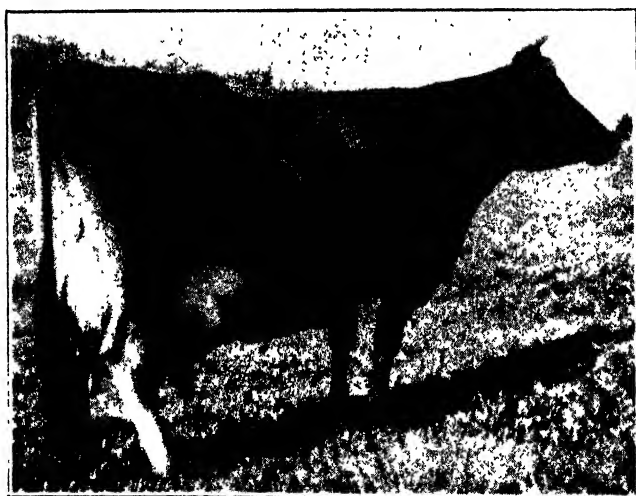
Three times first and champion Perth Royal Show. Also first and champion Bunbury, Bridgetown, Busselton and Donnybrook. A "proved" sire, some of whose daughters are found in Mr. J. A. Sears' herd, the eight cows of which averaged 320.5 lbs. of fat in 273 days.



Pure bred A.I.S. bull "Millions of Maxicar." Seventy per cent. of the bulls owned by members are pure bred, the aim being 100 per cent. pure bred in five years.

TABLE 12.—COOKERNUP (UNIT "C"). RECORDER W. KERR.

Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.		%	lb.	
O. C. Rath	9	4,654		4.56	212.22	
H. D. Hardy	20	5,081		3.77	191.56	
J. A. B. Hay	24	4,687		3.98	186.55	
Herd "E"	22	4,121		4.37	180.08	
" "B"	25	4,428		3.95	174.89	
" "M"	31	4,316		3.92	169.17	
" "J"	28	5,240		3.22	168.72	
" "D"	20	3,537		4.57	161.63	
" "F"	28	4,106		3.93	161.36	
" "T"	13	4,244		3.78	160.40	
" "U"	18	3,654		4.15	151.65	
" "P"	19	4,164		3.63	151.16	
" "S"	49	3,708		4.00	148.32	
" "A"	23	4,056		3.65	147.24	
" "K"	29	3,369		4.35	146.53	
" "W"	16	3,592		3.85	138.28	
" "O"	26	3,217		3.80	122.76	
" "V"	29	3,259		3.67	119.59	
" "H"	14	2,876		3.96	113.88	
" "X"	17	3,058		3.70	113.15	
" "Y"	12	2,696		4.13	111.36	
" "R"	44	2,833		3.82	108.21	
" "N"	33	2,264		3.97	89.86	



"Precious," owned by B. Langridge, Donnybrook. Second highest producing cow tested during the year. 520.11 lbs. butter fat in 273 days; 599.0 lbs. butter fat in 365 days.



"Bishop," highest producing cow in Serpentine unit. Owner S. F. Russell. Production 880 gallons milk, 442 lbs. fat in 273 days.

TABLE 13.—HARVEY (UNIT "D "). RECORDER J. MORGAN.

Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.		%	lb.	
R. Hanks & Son	30	5,169		4.39	243.50	
H. M. & C. Gibbs	39	4,191		5.18	195.30	
F. Byrd	33	4,479		3.97	185.84	
Herd "S"	17	3,872		4.81	185.60	
" " "N"	24	2,566		4.49	185.08	
" " "C"	22	3,813		4.60	176.16	
" " "L"	21	2,397		4.12	176.11	
" " "M"	24	3,583		4.91	175.97	
" " "I"	35	3,177		4.45	175.30	
" " "H"	24	3,581		4.72	169.8	
" " "D"	15	3,917		4.30	169.17	
" " "E"	20	3,282		4.36	157.24	
" " "A"	30	3,330		4.55	161.03	
" " "R"	15	3,371		3.78	138.18	
" " "K"	10	2,883		4.73	137.03	
" " "F"	25	3,075		4.22	132.10	
" " "G"	58	2,872		4.38	123.90	
" " "P"	41	2,961		3.96	121.36	
" " "J"	24	3,013		4.10	119.20	
" " "V"	33	2,082		4.57	98.53	
" " "W"	13	716		3.6	25.77*	

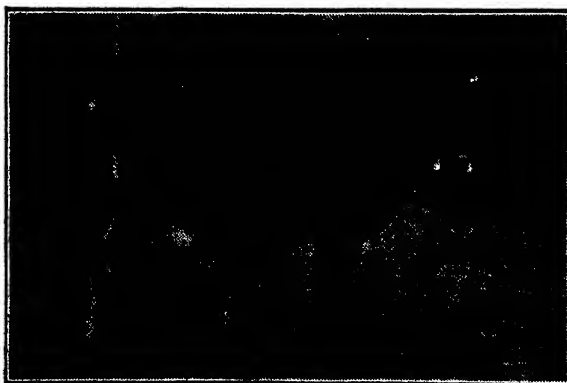
* One test only.



"Titbits," owned by L. C. Winduss, Cookernup. Production 932 gallons milk, 432 lbs. fat, in 273 days.



The highest producing herd in Harvey unit, owned by R. Hanks & Sons. Thirty cows averaged 243.5 lbs. fat in 273 days.



"Lily," highest producing cow in Brunswick unit. Owned by Flannagan Bros., "Riverlands." Production 640 gallons milk, 371 lbs. fat, in 273 days off grass.

TABLE 14.—BRUNSWICK (UNIT "E"). RECORDER A. HARDY.

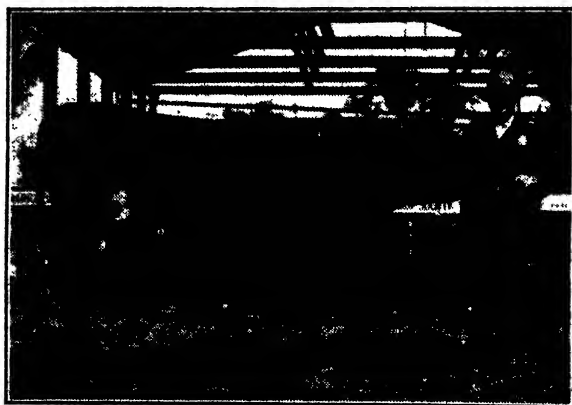
Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.		%	lb.	
S. Bowers	24	4,879		4.85	236.68	
W. Partridge	48	4,169		5.19	216.52	
R. Cruickshank	11	4,877		4.39	214.03	
Herd "C"	28	4,945		4.29	212.13	
" " "I"	45	4,307		4.37	188.42	
" " "O"	40	4,730		3.89	184.24	
" " "Q"	33	3,823		4.72	180.29	
" " "D"	19	3,559		5.01	178.50	
" " "H"	23	4,357		3.96	172.76	
" " "G"	63	3,622		4.61	167.02	
" " "E"	24	3,816		4.22	161.21	
" " "Y"	32	3,372		4.67	157.71	
" " "U"	33	3,265		4.73	154.55	
" " "L"	19	3,398		4.54	154.43	
" " "B"	47	3,512		4.13	145.05	
" " "R"	17	3,580		4.03	144.46	
" " "K"	27	3,574		4.04	144.25	
" " "A"	27	3,553		4.02	143.02	
" " "J"	24	2,971		4.63	137.59	
" " "S"	28	3,342		4.08	136.25	
" " "E"	37	2,756		4.70	129.65	

TABLE 15.—DARDANUP (UNIT "F"). RECORDER P. DEVLIN.

Owner.	Number of Cows.	Milk—		Average Test.	Butter Fat—	
		Average	per Cow.		Average	per Cow.
		lb.		%	lb.	
C. Richards	15	3,172		5.5	284.60	
W. Wood	18	5,190		4.78	248.00	
J. Strachan	18	5,203		4.52	235.52	
Herd "G"	27	4,667		4.98	232.50	
" " "A"	60	4,182		5.19	217.00	
" " "H"	32	4,549		4.41	200.60	
" " "E"	28	4,372		4.56	199.56	
" " "O"	10	4,035		4.54	183.15	
" " "J"	20	3,935		4.46	175.70	
" " "N"	21	3,879		4.50	174.50	
" " "U"	10	3,795		4.60	174.43	
" " "K"	32	4,229		4.12	174.10	
" " "V"	23	3,581		4.64	166.10	
" " "M"	26	3,791		4.05	163.60	
" " "R"	13	3,588		4.46	160.10	
" " "D"	38	3,400		4.70	158.80	
" " "T"	47	3,787		3.93	149.00	
" " "P"	3	2,940		5.04	148.30	
" " "L"	20	2,883		4.71	135.73	
" " "S"	12	3,026		4.20	127.10	
" " "Q"	15	2,281		4.52	103.14	



"Judy 1st." Production 772 gallons milk, 442 lbs. fat in 273 days. Owned by W. Wood, Dardanup. The "top cow" in the Dardanup unit.



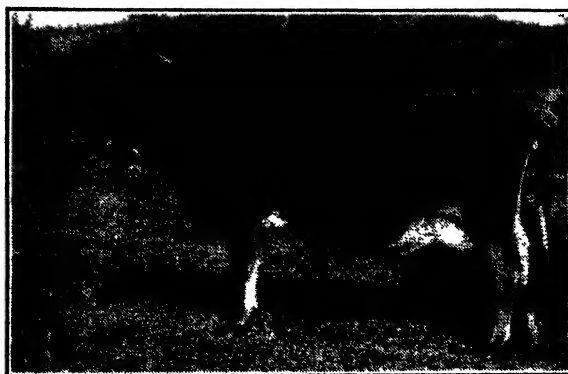
"Summerlea Togo," 1527, Vol. III. Bred by Dunkley Bros., Capel. Sire: Victor of Telyarup, 2498—Dam: Fairy 7th of Newstead. Togo has won six first prizes at Perth Royal, Bunbury and Busselton Shows and has not yet been beaten in his class. He was Reserve South-West Champion at Bunbury and Champion at Busselton, 1933. One of Mr. Dunkley's herds of 41 cows averaged 226.9 lbs. fat in 273 days off grass.

TABLE 16.—CAPEL (UNIT "G"). RECORDER R. RUTHERFORD.

Owner.	Number of Cows.	Milk— Average per Cow. lb.	Average Test. %	Butter Fat— Average per Cow. lb.
T. G. Hutton	28	6,861	3.72	248.91
Summerlea Pastoral Company, No. 1	41	5,493	3.85	226.94
C. A. McCormack	52	4,757	4.64	216.57
Herd "S"	29	5,528	3.83	212.18
" "H"	60	5,088	3.93	203.68
" "D"	36	5,130	3.93	198.11
" "M"	29	4,850	4.07	195.51
" "O"	47	4,279	4.29	181.62
" "I"	107	3,755	4.78	177.54
" "K"	22	4,185	4.25	174.38
" "A"	64	3,779	4.42	169.18
" "E"	38	4,289	3.97	166.60
" "P"	32	3,998	4.03	162.14
" "J"	60	3,451	4.42	161.55
" "C"	48	3,658	4.08	147.06
" "V"	35	3,742	3.78	144.59
" "L"	155	2,942	4.23	123.86

TABLE 17.—BALINGUP (UNIT "H"). RECORDER K. SIMES.

Owner.	Number of Cows.	Milk— Average per Cow. lb.	Average Test. %	Butter Fat— Average per Cow. lb.
S. C. Maidment	21	5,233	4.21	220.74
H. Scarr	26	4,965	4.39	218.22
A. S. Wright	11	4,633	4.48	207.73
Herd "J"	25	4,233	4.89	207.28
" "B"	6	3,944	5.20	206.43
" "X"	24	4,365	4.56	199.47
" "W"	12	4,837	4.02	194.45
" "N"	23	4,048	4.74	192.25
" "K"	20	3,747	4.96	186.01
" "C"	26	3,770	4.87	183.66
" "Q"	7	4,060	4.51	183.51
" "O"	11	3,988	4.52	180.64
" "E"	25	3,952	4.43	175.33
" "R"	9	3,833	4.44	170.13
" "U"	24	3,400	4.61	156.91
" "I"	16	3,329	4.34	144.50
" "F"	10	3,100	4.65	144.41
" "P"	28	3,092	4.44	137.43
" "M"	20	3,173	4.03	128.09
" "G"	26	2,703	4.53	122.66
" "A"	14	3,023	4.03	121.99



"Buttercup" produced 849 gallons milk, 413.1 lbs. fat, in 278 days. Owner Mr. S. C. Maidment, Balingup.

TABLE 18.—LEADING THREE HERDS IN EACH UNIT.

Unit.	No. of Cows.	Bull.	Milks.	Test.	Fat.	Owner.
A.—Donnybrook	8	P.B.J.	lbs. 5,974.00	% 5.30	lbs. 320.51	J. A. Sears
	20	P.B.J.	5,949.00	5.20	310.60	W. Noon
	16	P.B.J.	5,970.00	4.80	293.71	A. Trigwell
B.—Serpentine...	36	P.B.A.	5,631.00	4.09	230.45	S. F. Russell
	22	P.B.F.	6,129.00	3.57	219.02	G. Bett
	27	...	5,099.00	4.13	210.63	A. H. G. Heath
C.—Cookernup...	9	P.B.G.	4,654.16	4.56	212.22	O. C. Rath
	20	M.S.	5,081.40	3.77	191.56	H. D. Hardy
	24	M.S.	4,687.40	3.98	186.55	J. A. B. Hay
D.—Harvey ...	30	M.S.	5,169.80	4.39	243.50	R. Hanks & Sons
	39	J.	4,190.90	5.18	195.30	H. M. and C. Gibbs
	33	F.	4,479.09	3.97	185.84	F. Byrd
E.—Brunswick...	24	J.	4,879.00	4.85	236.68	S. Bowers
	48	J.	4,169.00	5.19	216.52	W. Partridge
	11	...	4,877.00	4.39	214.03	R. Cruikshank
F.—Dardanup ...	15	Grade J. (now P.B.)	5,171.70	5.50	284.60	C. Richards
	18	J.	5,190.25	4.78	248.00	W. Wood
	18	J.	5,203.70	4.52	235.52	J. Strachan
G.—Capel ...	28	F.	6,860.68	3.72	248.91	T. G. Hutton
	41	M.S.	5,943.00	3.85	226.94	Summerlea Pas- toral Co. No. 1
	52	J.	4,757.40	4.65	216.57	C. A. McCormack
H.—Balingup ...	21	M.S.	5,233.00	4.21	220.74	S. C. Maidment
	26	...	4,965.00	4.39	218.22	H. Scarr
	13	...	4,633.00	4.48	207.73	A. S. Wright

Includes all cows tested 100 days or more.



A good appetite means high production. Mr. F. Byrd's cow at Harvey.

HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE-BRED DAIRY CATTLE
PRODUCTION TESTING SCHEME, 1933-34.

G. K. BARON-HAY (Superintendent of Dairying).

For the year ended 30th June, 1934, 247 pure-bred cows completed their lactation period, the average production being 306.65 lb. butter fat per cow without allowances for age.

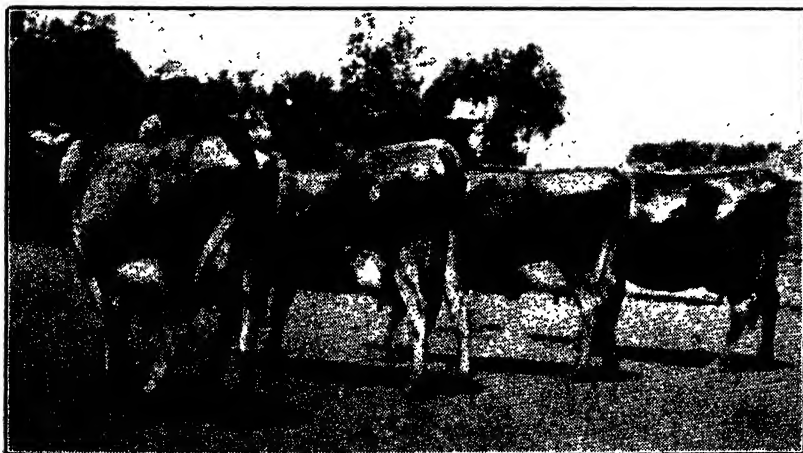
The following table shows the average production of butter fat of all cows which completed their lactation period according to each class:—

	Number of cows.	Average Butter Fat. lb.
1. Mature	66	339.40
2. Senior 4 years	21	370.76
3. Junior 4 years	14	291.82
4. Senior 3 years	27	312.52
5. Junior 3 years	29	292.85
6. Senior 2 years	25	285.23
7. Junior 2 years	65	269.39
Total	247	Av 306.65

The trophy for the dairy sire with the greatest number of daughters to exceed the official standard during the year was won by the Australian Illawarra Short-horn bull "Triumph of Pine Creek," owned by the Wooroloo Sanatorium Farm. Fourteen daughters completed the test during the year, the average production being 325.59 lb. butter fat at an average age of 2 years 10½ months. This bull is undoubtedly one of the outstanding dairy sires in the State.

It is instructive to notice that his 17 daughters tested in 21 lactation periods, the average production was 312.3 lb. butter fat at an average age of 2 years 9 months. The dams of these daughters produced an average of 283 lb. butter fat. The daughters, therefore, showed an average improvement of 13.7 per cent. over the dams.

A Fine Team Owned by S. P. Herbert, "Nooka," Nungarin.



Left to right: "Nooka Ragtime Rose," 1 year 11 months, 310 lbs. fat in 273 days; "Nooka Carnation," junior, 3 years, 407 lbs. fat in 273 days, highest production for the age and breed, second all breeds under official Government test in 1932; "Nooka Wild Rose," senior 2 years, 358 lbs. fat in 273 days, first all breeds official Government Test in 1932; "Nooka Lass," senior 2 years old, 330 lbs. fat, senior 3 years old, 370 lbs. fat in 273 days.

HERD TESTING.

THE OFFICIAL AUSTRALIAN PURE BRED DAIRY CATTLE PRODUCTION RECORDING SCHEME.

Conducted by Dairy Branch, Department of Agriculture, Western Australia.

Year ending 30th June, 1934.

G. K. Baron-Hay, Superintendent of Dairying.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk for Last day of Test.	Weight of Milk for period.	Average Test.	Butter Fat	Owner	Sire.
MATURE COWS (OVER 5 YEARS OLD)—STANDARD 350 LBS. BUTTER FAT.											
Koojan Bonnie Elizabeth	Guernsey...	1890	23-3-27	5-5-33	273	24½	9,253	6.2	570.97	A. W. Padbury	Robin of Nunlora 417
Kurraway Kitty 8th	A.I.S.	16030	30-4-26	22-8-33	273	35	10,535	4.6	525.92	W. G. Burges	Premier of Kurrawong 1212
Nancy 9th of Raleigh	do.	17319	30-4-27	22-8-33	273	34	10,535	4.6	525.92	W. G. Burges	Union Jack of Raleigh 2375
Sally of The Hill	do.	15741	8-10-27	30-7-33	273	28	13,162	3.96	521.82	W. G. Burges	Crescent of The Hill 2016
Pussy 5th of The Hill	do.	15729	8-10-27	30-7-33	273	28-5	12,535	3.95	506.71	W. G. Burges	Crescent of The Hill 2016
Grass Vale Lady Fowler 3rd	Jersey	19111	29-5-25	16-5-33	273	27	9,506	5.50	494.84	R. H. Rose	Rye Duke of Glen Iris
Gold of East View	A.I.S.	10040	1-5-26	14-8-33	273	20	14,055	3.47	488.06	W. G. Burges	Mariner of Greyleigh
Kathleen 5th of Kurrawong	do.	16027	13-12-25	31-7-33	273	31	11,978	4.0	480.61	W. G. Burges	Premier of Kurrawong 1212
Grass Vale Montrose Maid	Jersey	24029	18-6-27	31-7-33	273	27	9,442	5.07	473.69	W. G. Burges	Montrose East of Glen Iris
Karridale Pride	Guernsey	1981	16-10-27	26-8-33	273	27	8,906	5.1	477.79	R. H. Rose	Minnamurra Oliver Twist
Limelight's Camella of Wangara	A.I.S.	17870	24-7-27	27-5-33	273	31	10,908	4.2	465.84	W. G. Burges	Limelight of Darbarala
Tablasong Dove 4th	do.	14725	30-9-26	29-7-33	273	30	11,493	4.28	453.70	W. G. Burges	Mayflower Repeater of Hill View
Clarendon Lupin 4th	do.	2406	9-5-28	22-7-33	273	30	10,575	4.28	452.70	Hospital for Insane	Telcarup Prince of Glen Iris
Lady Mint's Gem 7th of Garden Hill	Jersey	20876	8-10-25	25-7-33	273	24-5	7,214	6.13	444.15	Robinson Bros.	Cream Socks of Glen Iris
Greenmount Bo-Peep	do.	20902	24-6-25	6-8-33	273	26-5	8,734	4.9	427.70	A. J. B. Strenpel	Veribee Starbright's King
Numbawarra Lu Lu	do.	4022	21-9-26	11-5-33	273	31	10,640	4.2	429.03	D. Began & Sons	Fairy's Fawn of Fairfield
Springmead Barbara	Jersey	13295	20-2-29	9-2-33	273	31-5	9,938	4.2	417.47	Sabina Vale Stud Farm	Springmead Germ
Wooroloo May 2nd	A.I.S.	15145	25-10-26	22-10-32	273	19-5	8,518	4.7	408.07	Wooroloo Sanatorium	Commercial of Blackheath
Nooka Pearl	Jersey	28189	2-12-27	6-12-32	273	20	6,930	5.7	400.64	S. P. Herbert	Jessie's King of Sardia
Picture 8th of Raleigh	A.I.S.	17524	22-4-27	19-3-33	273	35	10,710	3.9	396.82	D. Began & Sons	Union Jack of Raleigh 2375
Stone Hill Silver Mary	Jersey	23968	8-6-26	22-4-33	273	14	5,767	6.78	391.11	C. Krebs	Jessie's Chief of Roelands
Carnation of Minsthorpe	A.I.S.	...	6-5-26	8-11-32	273	8	8,724	4.4	387.25	F. Began & Sons	Prince of Sunnyvale
Greenmount Charming Lass	Jersey	20903	8-6-25	11-7-33	273	17-5	6,947	6.0	375.83	A. J. B. Strenpel	Veribee Starbright's King
Dennmark Anne	do.	1164	2-3-25	7-6-33	273	15	7,470	5.02	375.27	Dennmark Stud Farm	Unwood of Wollongbar
Wooroloo Red Rose	A.I.S.	2521	17-2-28	25-3-33	273	17-5	8,302	4.5	372.29	Wooroloo Sanatorium	Triumph of Pine Creek 2515
Clarendon Eyre Betty	Jersey	39244	28-4-29	30-5-33	273	22	9,126	4.05	369.78	Sabina Vale Stud Farm	Clarendon Eyre Eminent's Achiever
Pendant of East View	do.	...	...	...	...	...	...	...	...	...	Sultan of East View
Moorelands Agnes	A.I.S.	18339	18-6-28	5-7-33	273	22-5	11,077	3.3	367.68	A. E. Grant	Colonel of Melrose
Clarendon Biddy 8th	Jersey	23980	11-6-26	6-5-33	273	12-5	6,967	5.2	366.95	P. Rose	Telcarup Prince of Clarendon
Clarendon Biddy 8th	A.I.S.	17908	10-8-27	19-1-33	273	18	9,069	4.06	365.40	Clarendon Hospital for Insane	Telcarup Prince of Clarendon
Mureak Buttercup	Guernsey...	17909	19-4-27	20-4-33	273	21	7,008	5.2	363.99	Mureak Agricultural College	Triumph of Wollongbar 513

HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk of Test.	Weight of Milk for period.	Average Test.	Butter Fat.	Owner.	Sire.
Moordlands Collie ...	Jersey	28210	15-5-28	30-3-33	273	13	lb. 6.429	5.0	121.10	P. Rose	Colonel of Melrose
Moordlands Cress ...	do.	28211	17-5-28	28-3-33	273	9.5	5.593	5.4	306.29	P. Rose	Colonel of Melrose
Venus 8th of Raleigh ...	A.I.S.	17540	3-2-28	10-10-33	240	15.5	8.370	3.9	323.78	D. Bevan & Sons	Royal Standard of Darbarala
Kurrawong Royal Lady ...	Guernsey	2333	10-10-28	7-8-33	273	23	6.579	4.77	313.92	E. D. P. Hayes	Minamurra Oliver Twist
Kurrawong Snowdrop 22nd ...	A.I.S.	18229	14-10-28	29-4-33	273	2.5	7.298	4.0	280.80	A. E. Grant	Merry Count of Berry
Murek Violet ...	Guernsey	21157	26-6-28	18-5-33	273	14	5.472	5.1	277.53	Murek College	Triumph of Wollongbar
Springmead Fern ...	Jersey	...	5-3-29	5-12-32	273	10	5.025	4.8	210.77	Sabbia Vale Stud Farm	Springmead Islander

COWS OVER 4 YEARS AND UNDER 5 YEARS—STANDARD 380 LBS. BUTTER FAT—continued.

COWS OVER 4 YEARS AND UNDER 4 YEARS—STANDARD 310 LBS. BUTTER FAT.

Talraup Duchess ...	A.I.S.	2504	9-12-28	4-8-33	273	42.5	13.792	3.8	592.84	A. E. Grant	Baron of Darbarala
Grass Vale Sweet Maggie 2nd ...	Jersey	28226	27-3-30	12-6-33	273	10.5	3.770.5	4.85	357.80	R. H. Rose	Starbright Sweet Duke of Glen Iris
Chippaway Pansy ...	A.I.S.	2442	2-12-28	25-3-33	240	28	7.391	4.5	334.41	A. E. Grant	Villiers of Darbarala
Greenmount Gipsey Lass ...	Jersey	28233	6-5-30	27-6-33	273	12	5.271	6.2	324.58	A. J. B. Strampel	Werrilee Starbright's King
Murek Princess ...	Guernsey	2527	9-3-29	10-4-33	273	15.5	5.954	5.4	324.10	Murek College	Triumph of Wollongbar
Marshall Nancy 3rd ...	A.I.S.	31235	14-5-29	17-5-33	273	15	7.320	4.2	311.43	D. Bevan & Son	Premier 2nd of Kurrawong
Marshall Rose 3rd ...	Jersey	2523	8-1-29	20-6-33	240	6	5.995	4.78	235.17	P. Rose	Melrose Bence
Moordlands Dura ...	Guernsey	31233	27-5-29	4-6-33	240	8	4.945	5.60	231.67	Denmark Stud Farm	Wollongbar Reformer
Moordlands Dura ...	do.	31234	15-11-28	3-5-33	240	8	4.920	5.6	231.88	P. Rose	Melrose Bence
Moordlands Dura ...	do.	31240	29-1-29	15-6-33	273	9	4.272	5.70	243.40	P. Rose	Melrose Bence
Tabbago Society 7th ...	A.I.S.	1595	7-1-29	7-2-33	240	10	6.180	3.7	225.12	W. G. Burges	Daisy's Gift of Hill View
Moordlands Dot ...	Jersey	31236	16-1-29	6-8-33	210	11.5	4.050	4.98	200.01	P. Rose	Melrose Romeo
Little 5th of Kurrawong ...	A.I.S.	18225	8-11-28	11-2-33	120	24.5	3.150	...	126.80	W. G. Burges	Premier 2nd of Kurrawong

COWS OVER 3 YEARS AND UNDER 4 YEARS—STANDARD 290 LBS. BUTTER FAT.

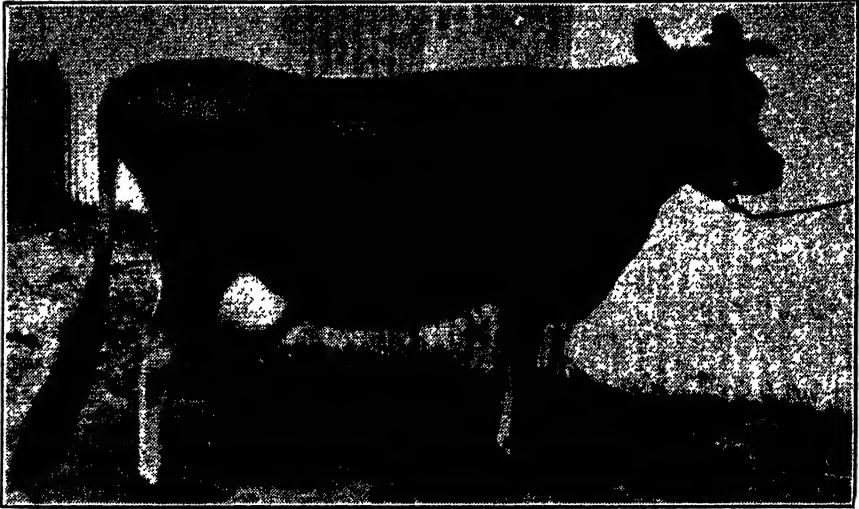
Woolroo Rose 2nd ...	A.I.S.	2523	27-4-29	1-3-33	273	19	9.042	4.5	417.85	Woolroo Sanatorium Farm	Triumph of Pine Creek
New Park Sally 7th ...	do.	1865	14-6-29	31-1-33	273	34	10.902	3.7	400.07	W. G. Burges	Ruler of Greyleigh (1855)
New Park Sally 9th ...	do.	1873	30-4-29	4-4-33	273	23	10.339	3.9	399.58	W. G. Burges	Regent of Greyleigh (1855)
Tabbago Tony 12th ...	do.	4472	18-12-29	14-7-33	273	32	10.161	3.8	389.69	A. E. Grant	Regent of Tabbago
Brookfield's Lady Lillian ...	Guernsey	2720	28-11-29	7-7-33	273	22.5	7.508	5.06	380.16	G. E. Scott	Koolan Lord Barclay
Moordlands Duchess ...	Jersey	31239	11-7-29	5-5-33	273	13	7.134	5.2	364.11	P. Rose	Melrose Romeo
Marshall Myrtle ...	Guernsey	2541	20-10-29	29-7-33	273	23	7.014	5.08	352.70	E. D. P. Hayes	Minamurra Prairie Don
Woolroo Red Rose II. ...	A.I.S.	2522	25-6-29	19-5-33	273	15	7.605	4.5	338.43	Woolroo Sanatorium Farm	Triumph of Pine Creek
Minamurra Palm Olive ...	Guernsey	2616	30-9-29	27-4-33	273	17	6.906	4.7	331.09	Murek College	Gramana Favour

COWS OVER 3 YEARS OLD AND UNDER 3½ YEARS—STANDARD 270 LBS. BUTTER FAT.									
	30-12-29	20-8-33	273	21	7,668	1 38	330-32	Woolooloo Sanatorium	Triumph of Pine Creek
Woolooloo Lass	...	...	...	...	...	...	...	B. Bee & Sons	Melba's Re-Echo of Tipperary
Melba 3rd of Tipperary	2358	11-10-29	12-4-33	273	21	7,863	4-0	Farm	Springfield Eastern King
Springfield Eastern Jewel	2390	1-12-29	12-7-33	273	23	6,384	5-0	Murek College	Melrose Raleigh
Moorlands Dingle	3121	9-7-29	24-5-33	273	13-5	6,610	4-77	P. Rose	Minnamurra Justice
Minnamurra Sun Lady	2311	25-2-29	28-9-33	273	20	5,790	5-44	Murek College	Nundorah Buceaneer
Wyana Jean	2471	8-9-29	15-5-33	273	16	6,603	4-8	Murek College	Collier of Darbala
Minamurra Treasury Lass	2477	20-10-29	28-5-33	273	14	6,747	4-5	R. Bee & Sons	Caranama Favour
Minnamurra Currency Lass	2606	7-10-29	28-4-33	273	14	6,162	5-0	Murek College	Grass Vale Carnation's Best
Stone Hill Mary 2nd	31197	4-10-29	18-9-33	273	13-5	5,110	296-74	Murek College	Triumph of Wollonghor
Murek Petunia	2706	29-11-29	27-9-33	273	19	5,582	5-35	Murek College	Montrose East of Glen Iris
Nooka Wild Rose	29191	31-12-28	28-12-32	273	17-5	5,935	4-7	S. P. Herbert	Banyule Super Strain
Banyule Silvermine 59th	29033	10-2-29	28-12-32	273	21	5,973	4-6	Savina Vale Stud Farm	Rose Chief of Wollonghor
Denmark Red Rose 3rd	2521	6-3-29	13-1-33	273	14	4,467	5-8	Denmark Stud Farm	Telaryup Count
Rannock Blue Bell	5183	5-2-30	14-8-33	273	12	6,531	3-99	D. Bevan & Sons	Nundorah Buceaneer
Wyana Goldie	2470	12-10-29	2-6-33	273	20	1,951	5-1	Murek College	Clarendon Eyre Enluent's Master
Clarendon Eyre Tangerine 2nd	33952	24-4-29	28-11-32	273	12	5,491	5-1	Savina Vale Stud Farm	
Glasvorn Verna	2369	6-4-29	25-10-32	240	19	5,370	4-1	D. Bevan & Son	Pine Creek Dunbar
Banyule Silvermine 66th	29847	10-9-29	3-6-33	90	34	3,090	..	Savina Vale Stud Farm	Milkmaid's Chief of Banyule
COWS OVER 3 YEARS OLD AND UNDER 3½ YEARS—STANDARD 270 LBS. BUTTER FAT.									
	7-4-30	14-8-33	273	29-5	6,883	5-50	383-00	S. P. Herbert	Spring Park Prince Ragtime
Nooka Ragtime Rose	34743	7-4-30	14-8-33	273	29-5	6,883	5-50	S. P. Herbert	Cookalabal Pride 2nd
Cookalabal Jewel	3771	18-9-29	10-2-33	273	24	7,497	4-8	A. W. Padbury	Colmyn Captain Mack
Colmyn Callene Rye	34751	10-8-30	20-9-33	273	16	6,903	5-1	C. H. Ironmonger	Minnamurra Prairie Don
Burnside Judy	2540	5-5-29	20-10-32	273	14-5	5,083	5-8	E. D. P. Hayes	Valiant Prince of Glen Iris
Springhurst Melilot 4th	33848	2-4-30	23-4-33	273	20-5	6,451	5-3	Savina Vale Stud Farm	Melrose Raleigh
Moorlands Elsie	34809	20-4-30	27-7-33	273	10	6,540	5-2	P. Rose	Melrose Romeo
Moorlands Elsie	34803	12-6-30	26-5-33	273	10	6,195	5-1	P. Rose	Mayflower's Monarch of Parkview
Widgee Waas Beauty 7th	5116	19-4-30	26-9-33	273	20	8,385	3-9	W. G. Burgess	Melrose Raleigh
Moorlands Elsie	34805	16-6-30	26-5-33	273	9-5	5,998	5-1	P. Rose	Starbright's Prince of Glen Iris
Springhurst Belladonna 4th	33844	12-2-30	13-1-33	273	16-5	6,124	5-1	Savina Vale Stud Farm	Banyule Super Strain
Berrington Soprano 2nd	28851	5-10-29	19-1-33	273	19-5	5,263	5-9	Savina Vale Stud Farm	Valiant Prince of Glen Iris
Springhurst Countess V	33847	29-3-30	29-5-33	273	9-5	5,488	5-5	Savina Vale Stud Farm	Melrose Romeo
Moorlands Elaine	34800	13-4-30	23-6-33	273	10	5,910	5-10	P. Rose	Wollonghor Satisfaction (96th)
Wollonghor Roebuck 2nd	2780	10-1-30	14-2-33	273	16	6,243	1-9	Denmark Stud Farm	Searchlight of Sunnyside
Clarendon Maggie 3rd	2359	9-9-29	1-3-33	240	23	7,245	4-00	Hospital for Insane	Villiers of Darbala
Tipperary Priscilla	2392	16-12-29	7-1-33	273	22	7,044	4-1	R. Bee & Sons	Clarendon Eyre (447)
Clarendon Biddy 13th	34814	28-8-29	16-10-32	273	13-5	6,951	4-3	Hospital for Insane	(Choice Goods of Garden Hill)
Grass Vale Ethel	34804	2-4-30	13-8-33	240	12-5	5,055	5-5	P. Rose	Melrose Raleigh
Moorlands Elaine	34754	4-7-29	20-9-33	273	9-5	5,603	5-10	C. H. Ironmonger	Colmyn Captain Mack
Colmyn Nellie Rye	2377	13-11-28	22-10-32	273	9	6,072	4-3	R. Bee & Sons	Melba's Re-Echo of Tipperary
Tipperary Royal Lady	2764	29-1-30	5-2-33	273	18	5,004	5-1	Denmark Stud Farm	Springfield Eastern King
Springfield Deadmona	2472	12-11-29	6-1-33	273	15	5,740	5-3	Denmark Stud Farm	Nundorah Prosper (964)
Wyana Lady Dawn	3284	17-8-30	23-8-33	273	13	5,074	4-66	Murek College	Murek Minelass
Denmark Rose 4th	2794	3-8-29	27-12-32	273	16	5,213	4-8	Denmark Stud Farm	Wollonghor Reformer
Melrose Bluebell	2204	12-9-28	15-2-33	273	20	6,210	5-04	H. O. T. Hm	Barugh Dairyman
Spring 5th of Mini	33650	11-9-30	11-7-33	273	15	4,725	4-9	Savina Vale Stud Farm	Valiant of Glen Iris
Moorlands Sparavis	34767	11-4-30	1-7-33	240	25	4,662	4-9	P. Rose	Melrose Raleigh
Moorlands Edith	2492	30-11-29	16-2-33	240	11-5	3,535	..	Denmark Stud Farm	Wollonghor Hopeful

HERD TESTING—continued.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Calving.	No. of Days in Test.	Weight of Milk of Last day of Test.	Weight of Milk for period.	Average Test.	Butter Fat.	Owner.	Sire.
COWS OVER 24 YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.											
Wooreloo Betty II.	A.I.S.	..	10-11-30	14-5-33	273	26-5	9,215	4-4	406-47	Wooreloo Sanatorium Farm	Triumph of Pine Creek
Claremont Whiskey Maid 11th	do.	..	2-6-30	1-5-33	273	36	10,398	3-9	398-38	Claremont Hospital for Insane	Claremont Elector
Kooka Lass	Jersey	28197	14-1-29	25-12-32	273	23-5	7,780	4-8	370-75	S. P. Herbert	Jessie's King of Sarnia
Claremont Poppy 3rd	A.I.S.	..	16-3-30	11-3-33	273	34-5	9,178	4-0	307-05	Claremont Hospital for Insane	Claremont Elector
Staghorn Northark's Matilda	Jersey	34787	9-8-30	7-8-33	273	28	6,819	5-25	358-30	Robinson Bros.	Staghorn Northark's Masterpiece
Greshorn Starbright's Marlboro	do.	34841	31-5-30	6-4-33	273	16	6,298	5-67	356-51	A. J. B. Stremmel	Veribee Starbright's Butter King
Grangeley Pretty Princess	do.	330388	31-10-29	29-10-32	273	22	6,171	5-9	354-13	Sabina Vale Stud Farm	Banyule Alro (5/51)
Grassvale Butler Queen	do.	40071	8-7-30	3-6-33	240	15	5,070	6-61	335-67	R. H. Rose	Staghorn Butler's Masterpiece 2nd
Claremont Laura 3rd	A.I.S.	8828	26-4-31	4-0-33	273	21	7,893	4-19	331-26	Claremont Hospital for Insane	Claremont Elector
Parkview Tot 2nd	do.	4137	30-1-31	21-8-33	273	26-5	7,220	4-16	323-85	W. G. Burges	Fussy's Gay Lad of Hillview
Kurrawong Bluebell 10th	do.	4245	5-12-30	13-8-33	273	17	7,701	4-15	300-34	D. Bevan & Sons	Standard of Oxy Camp
Mokine Miss Fox	Jersey	..	24-11-29	11-10-32	273	18	5,589	5-0	272-88	T. H. Wilding	Twylish Fox of the Valley
Judaine Juliet 6th	do.	34344	20-10-29	10-10-32	273	15	4,690	5-8	272-99	Miss L. Hancock	Mokine Repulse
Claremont Cocky 7th	A.I.S.	8828	3-1-31	20-9-33	240	14	6,600	3-99	283-42	Hospital for Insane	Searchlight of Sunnyvale
Woodstock Modern Lady	Guernsey	3328	27-11-30	26-8-33	273	19	5,577	4-69	261-79	A. G. Haynes	Homestead Ace
Mureak Boronia	do.	3285	19-8-30	7-5-33	273	12	4,266	6-0	254-07	Mureak College	Triumph of Wollongbar
Moortlands Elsie	Jersey	34801	19-8-30	22-5-33	240	10-5	4,440	5-49	243-81	P. Rose	Melrose Raleigh
Tipperary Pride	A.I.S.	2376	20-2-30	12-11-32	273	22-5	6,187	3-9	239-72	D. Bevan & Sons	Melba's Be-Echo of Tipperary
Colwyn Winnie Rye	Jersey	34757	5-3-31	2-3-33	273	11	4,878	5-09	233-10	C. H. Ironmonger	Rye Duke of Glen Iris
Denmark Rose Pearl 5th	Guernsey	3281	30-12-29	2-3-33	273	15	4,245	5-4	229-90	Denmark Stud Farm	Reformer of Wollongbar (538)
Mokine Empire Twylish	Jersey	..	15-2-30	13-10-32	273	13	4,569	5-1	226-02	T. H. Wilding	Twylish Fox of the Valley
Mokine Veronica 6th	do.	31194	10-11-29	17-9-32	240	9	3,780	4-7	197-67	T. H. Wilding	Twylish Fox of the Valley
Grangeley Xmas Eve	do.	34813	24-12-30	14-10-33	120	17-5	2,940	5-40	160-11	R. H. Rose	Rye Duke of Glen Iris
Springmead Island Flower	do.	..	5-5-30	10-1-33	273	6-5	3,154	4-6	143-68	Sabina Vale Stud Farm	Campaules Duke of Burekup
COWS UNDER 24 YEARS—STANDARD 230 LBS. BUTTER FAT.											
Kooka May Queen	Jersey	41293	3-5-31	24-9-33	273	22	7,888	5-22	412-12	S. P. Herbert	Springpark Prince Ragtime
Kooka Bo-Peep	Guernsey	3542	26-2-31	18-4-33	273	23	8,759	5-73	390-15	A. W. Padbury	Homestead Ace
Wooreloo Wing Wing 2nd	A.I.S.	..	2-5-31	7-6-33	273	30-5	8,596	4-35	373-64	Wooreloo Sanatorium Farm	Triumph of Pine Creek
Parkview Violet 12th	do.	4133	3-5-31	24-9-33	273	32	9,851	3-92	366-63	W. G. Burges	Regent of Tabbagong
Parkview Polly II.	do.	..	24-2-31	30-7-33	273	23	8,219	4-00	363-96	W. G. Burges	Regent's Monarch of Blacklands
Kooka Rosebud	Jersey	..	7-9-31	2-10-33	273	22	6,996	5-20	363-66	S. P. Herbert	Springpark Prince Ragtime
Widgee Waa Roy 5th	A.I.S.	5117	20-4-30	18-10-32	273	34	9,252	3-8	359-21	W. G. Burges	Widgee's Monarch of Parkview
Claremont Cleggett 4th	A.I.S.	..	24-11-30	13-4-33	273	29	8,472	4-0	340-50	Hospital for Insane	Searchlight of Sunnyvale
Denmark Rose Pearl 6th	Guernsey	3282	18-12-31	19-0-33	273	20	6,295	5-16	324-68	Denmark Stud Farm	Wollongbar Reformer
Wooreloo Red Rose 3rd	A.I.S.	5226	27-0-30	2-2-33	273	18-5	6,325	4-92	310-92	Wooreloo Sanatorium Farm	Triumph of Pine Creek
Claremont Beanie 4th	do.	..	11-8-30	21-10-32	273	16	7,068	4-4	305-36	Hospital for Insane	Searchlight of Sunnyvale
Tarvalgan Lady Mint	Jersey	..	21-7-30	19-12-32	273	24	5,517	5-5	308-66	Robinson Bros.	Fern's Masterpiece of Glaston Hill
Parkview Lady May 23rd	A.I.S.	..	1-6-31	19-0-33	273	21	8,103	3-74	303-07	W. G. Burges	Daphne's Defiance of Hillview

Glasgow Penelope	2366	21-8-30	24-11-32	273	20	7.287	4-1	801-58	D. Devan & Sons	Villiers of Darbala
Woorloo Sunshine	5227	13-2-31	30-7-33	273	17	6.806	4-8	301-50	Woorloo Sanatorium	Triumph of Pine Creek
Woorloo Marjaret	5223	7-10-30	25-3-33	273	18	6.830	4-4	300-82	Woorloo Sanatorium	Triumph of Pine Creek
Koolan Myrmaid	3543	18-2-31	22-2-33	273	8-5	4.810	6-2	293-64	A. W. Padbury	Homestead Ace
Parkview Popsy 3rd	4135	20-9-30	20-1-33	273	21	7.393	4-0	293-94	W. G. Burges	Mayflower's Repeater of Hillview
Tabagoong Fairy 8th	7114	17-7-31	21-8-33	273	17	7.011	4-14	290-50	W. G. Burges	Parkview Renard 2nd
Woorloo Fairy	41100	14-7-31	21-8-33	273	10	5.445	5-20	287-26	P. Rose	Melrose Raleigh
Sabina Vale Lass	3569	10-7-31	13-10-33	273	18-5	5.135	5-51	284-32	Sabina Vale Stud Farm	Melrose Alro
Denmark High Lass	5218	30-8-30	12-12-32	273	18	5.544	5-1	280-52	Denmark Stud Farm	Denmark Empire Chief
Woorloo Bloomer	5218	5-10-30	11-2-33	273	18	6.389	4-4	280-19	Woorloo Sanatorium	Triumph of Pine Creek
Grass Vale Cream Duchess	...	4-4-31	9-4-33	273	17	5.678	4-0	276-11	R. J. B. Rose	Campaniles Duke of Burekup
Mokine Amy	...	5-9-30	4-10-32	273	10	5.692	4-8	270-62	T. H. Wilding	Mokine Repulse
Woorloo Jean	5221	15-7-30	9-11-32	273	15	6.405	4-2	269-95	Woorloo Sanatorium	Triumph of Pine Creek
Nooka Daisy	...	27-2-31	7-11-32	273	14-5	4.993	5-3	268-53	S. P. Herbert	Spring Park Prince Ragtime
Woorloo Kitty	...	28-4-31	7-8-33	273	16	6.153	4-3	264-64	Woorloo Sanatorium	Triumph of Pine Creek
Greenmount Little Gem	34839	9-6-31	24-2-33	273	13-5	4.870	5-4	264-01	A. J. B. Stremple	Grantham Easter King
Moortlands Florie	...	10-6-31	23-3-33	273	12-5	5.152	5-1	258-47	P. Rose	Melrose Sultan
Parkview Model	...	20-10-30	29-11-32	273	23	6.614	3-9	255-79	E. D. P. Hayes	Joan's Monarch of Blacklands
Burnside Ladybird	3522	8-10-30	4-11-32	273	14	5.352	4-7	255-02	W. G. Burges	Denmark Radiant Chief
Springmead Lady Rose	...	26-7-30	14-12-32	273	24	5.892	4-4	255-51	Sabina Vale Stud Farm	Springmead Beaucare (6315)
Moortland's Flower	...	19-6-31	8-5-33	273	7	4.461	5-7	254-12	P. Rose	Melrose Clarion
Moortland's Fiona	...	16-9-31	18-5-33	273	13-5	4.860	5-0	252-04	P. Rose	Melrose Sultan
Nooka Violet	...	18-2-32	12-8-33	273	10-5	4.300	5-85	251-45	S. P. Herbert	Springpark Prince Ragtime
Colony Nellie Rye	34754	8-7-30	8-10-32	273	9-5	5.498	4-6	251-09	C. H. Ironmonger	Colony Captain Mack
Woorloo Lily	7741	2-6-31	26-7-33	273	14	5.397	4-6	250-69	Claremont Hospital for Insane	Triumph of Pine Creek
Nooka May Queen	41283	3-5-31	4-11-32	273	16-5	5.044	5-0	250-42	S. P. Herbert	Springpark Prince Ragtime
Colony Monica	39325	25-9-31	4-9-33	273	9	4.787	5-27	249-67	C. H. Ironmonger	Colony Captain Mack
Denmark Rosa 5th	3279	18-4-31	5-9-33	273	15	4.755	5-21	248-01	E. D. P. Hayes	Wollongbar Reformer
Burnside Myra Bell	3323	18-3-31	22-7-33	273	18	5.334	4-62	246-87	F. D. P. Hayes	Denmark Radiant Chief
Greenmount Bonnie Maid	34835	15-5-31	10-9-33	273	10	4.365	5-6	246-85	A. J. B. Stremple	Grantham Starlight's King
Moortlands Flo	41102	20-8-31	31-5-33	273	11 5	4.804	5-1	245-09	P. Rose	Melrose Clarion
Widgees Was Beauty 7th	5116	19-4-30	14-10-32	273	13	6.099	4-0	244-96	W. G. Burges	Mayflower's Monarch of Parkview
Longridge Gentry	5016	6-1-31	10-5-33	273	16	5.838	4-2	241-71	R. Bee & Sons	Minathorpe Kitchener
Moortlands Fanny	41097	7-6-31	1-6-33	273	9	4.457	5-30	241-48	P. Rose	Melrose Raleigh
Woorloo Duchess	...	4-4-31	8-8-33	273	16	5.013	4-78	239-66	Woorloo Sanatorium	Triumph of Pine Creek
Colony Rye Rose	...	15-10-30	29-12-32	273	18	4.846	4-9	238-79	C. H. Ironmonger	Rye Duke of Glen Iris
Parkview Popsy	4127	6-4-31	12-8-33	273	21	6.093	3-9	238-74	W. G. Burges	Daphne's Dedance of Hillview
Tabagoong Popsy 18th	7503	7-8-31	12-8-33	273	17	5.706	4-12	235-02	W. G. Burges	Parkview Renard 2nd
Woolongbar Gentle Lass	34558	9-2-31	17-4-33	273	10	4.275	5-5	234-63	A. J. B. Stremple	Grantham Starlight's King
Spring Park Clarion	...	16-7-31	14-3-33	240	12	3.990	5-87	234-33	L. Temple	Melrose Clarion
Denmark Rose Dame 2nd	3290	18-7-31	30-10-32	273	13	4.975	4-7	233-90	Denmark Stud Farm	Wollongbar Reformer
Greenmount Marinette	34640	2-5-31	27-3-33	273	13	4.614	5-0	231-18	A. J. B. Stremple	Grantham Starlight's King
Greenmount Easter Pride	...	2-5-31	27-3-33	273	9 5	4.048	5-07	228-53	P. Rose	Grantham Easter King
Moortlands Fuschia	41106	30-6-31	25-5-33	273	11 5	4.453	5-0	224-93	C. H. Ironmonger	Melrose Raleigh
Colony Poppy	34753	13-8-30	10-10-32	273	11	3.968	5-0	224-93	R. J. B. Rose	Rye Duke of Glen Iris
Murak Lady Rye	...	1-8-30	8-11-32	273	17 5	4.896	4-5	216-81	E. D. P. Hayes	Triumph of Wollongbar
Burnside Princess	3324	6-2-31	27-12-32	273	13	3.820	5-5	210-87	W. G. Burges	Denmark Radiant Chief
Travalean Ice Cream	...	30-9-30	20-10-32	273	17	4.461	4-0	210-07	T. H. Wilding	Banyule Altitude
Mokine Sapphire	...	7-6-31	17-9-33	273	11	3.483	5-92	206-82	Dr. H. Wilding	Mokine Repulse
Claremont King Lass	...	16-1-31	29-12-32	240	18	1.515	4-07	183-24	D. Devan & Sons	Claremont Forester (448)
Claremont Lupin 7th	5107	16-1-31	16-12-32	273	14	4.047	4-3	174-35	C. H. Ironmonger	Colony Captain Mack
Nooka Show Girl	34756	23-11-30	16-12-32	273	14	4.047	4-3	174-35	C. H. Ironmonger	Colony Captain Mack



BANYULE SILVERMINE 55th.

10,887 lbs. milk, 6.07 per cent. test, 660.55 lbs. butter fat in 273 days
as senior 4-year-old.



ROSE II. OF WOOROLOO, 2523.

Sire: Triumph of Pine Creek—Dam: Rose of Waterside. At 2 years 5 months of age.
Top cow in Senior 3-year old class. 1933-34, 9,042 lbs. Milk, 4.6% Test, 417.85 lbs. Fat.

CHART SHOWING PRICE OF BUTTER-FAT WHEN WHOLESALE PRICE OF BUTTER AND CHARGE FOR MANUFACTURE AND SALE ARE KNOWN.

Wholesale Factory Price of Butter.	Factory Charge for Manufacture and Sale and Price of Butter Fat per pound.												
	5d.	4½d.	4¼d.	4¼d.	4d.	3¾d.	3½d.	3¼d.	3d.	2¾d.	2½d.	2¼d.	2d.
1/9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5	22.8
1/8½	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2	22.5
1/8	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	21.6	21.9	22.2
1/8¼	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	21.6	21.9
1/8	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	21.6
1/7½	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3
1/7	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0
1/7¼	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7
1/7	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4
1/6½	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1
1/6	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8
1/6¼	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5
1/6	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2
1/5½	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9
1/5	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6
1/5¼	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3
1/5	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7	18.0
1/4½	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4	17.7
1/4	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.4
1/4¼	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8	17.1
1/4	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	16.8
1/3½	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5
1/3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2
1/3¼	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9
1/3	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6
1/2½	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3
1/2	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0
1/2¼	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7
1/2	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4
1/1½	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1
1/1¼	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5	13.8
1/1	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5
1/1	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2
1/0¾	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9
1/0½	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6
1/0	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3
1/-	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0
11½	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7
11¼	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4
11	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1
11	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8
10¾	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5
10½	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2
10¼	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6	9.9
10	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.6

If an equalisation levy is charged, this sum should be deducted from the above price for butter fat to arrive at the net price the farmer will receive.

JOURNAL OF AGRICULTURE.

Erratum.

Page 225, of "Journal of Agriculture," No. 2, Vol. 11, June, 1934. "Further Field Experiments with Manganese as a Control of Grey Speck Disease in Western Australia."

In Table 2, the figures given for Manganese (Mn) for Samples 1 and 2, as calculated from results supplied by the Government Analyst, should read .0220 and not .0078.

THE REDUCTION OF ORCHARDING COSTS.

By H. TARTLTON PHILLIPS, B.Sc., Eulomo, Balingup.

In consequence of the reduced price of apples, both at home and abroad, and the diminished margin between expenses and returns, it is impossible to consider the immediate future of the apple-growing industry without some feeling of apprehension.

Since the prices of apples are primarily governed by the general condition of the world's trade, it seems evident that there can be no marked recovery until it becomes possible for international trade to once more flow freely through its normal channels, and it is equally evident that a considerable time must elapse before this can be brought about. The grower of apples may therefore look forward to a more or less prolonged period of low prices, and, since he cannot do anything to raise the price of his product, will necessarily have to discover some means of reducing his working costs, if he wishes to survive.

When fruit prices were high, a few pence, more or less, per case, were not of great moment, but where the profits are of the order of 1/- per case, an extra sixpence means an increase of 50 per cent., and may make all the difference between success and failure. The time has therefore come when each grower must carefully review each item of his expenditure, in order to see whether some saving can be made.

What can be done will necessarily depend upon the conditions existing in each particular orchard, but it may be of interest to consider a few general principles, which are applicable to all. Apple-growing costs may be divided into two categories:—

1. Transport and marketing costs.
2. Costs on the orchard.

TRANSPORT AND MARKETING COSTS.

Although there is still scope for the opening up of new markets, for a more scientific distribution of fruit, and for a general reduction in the cost of transport and marketing, such questions cannot be handled by the individual grower, and therefore need not be considered here.

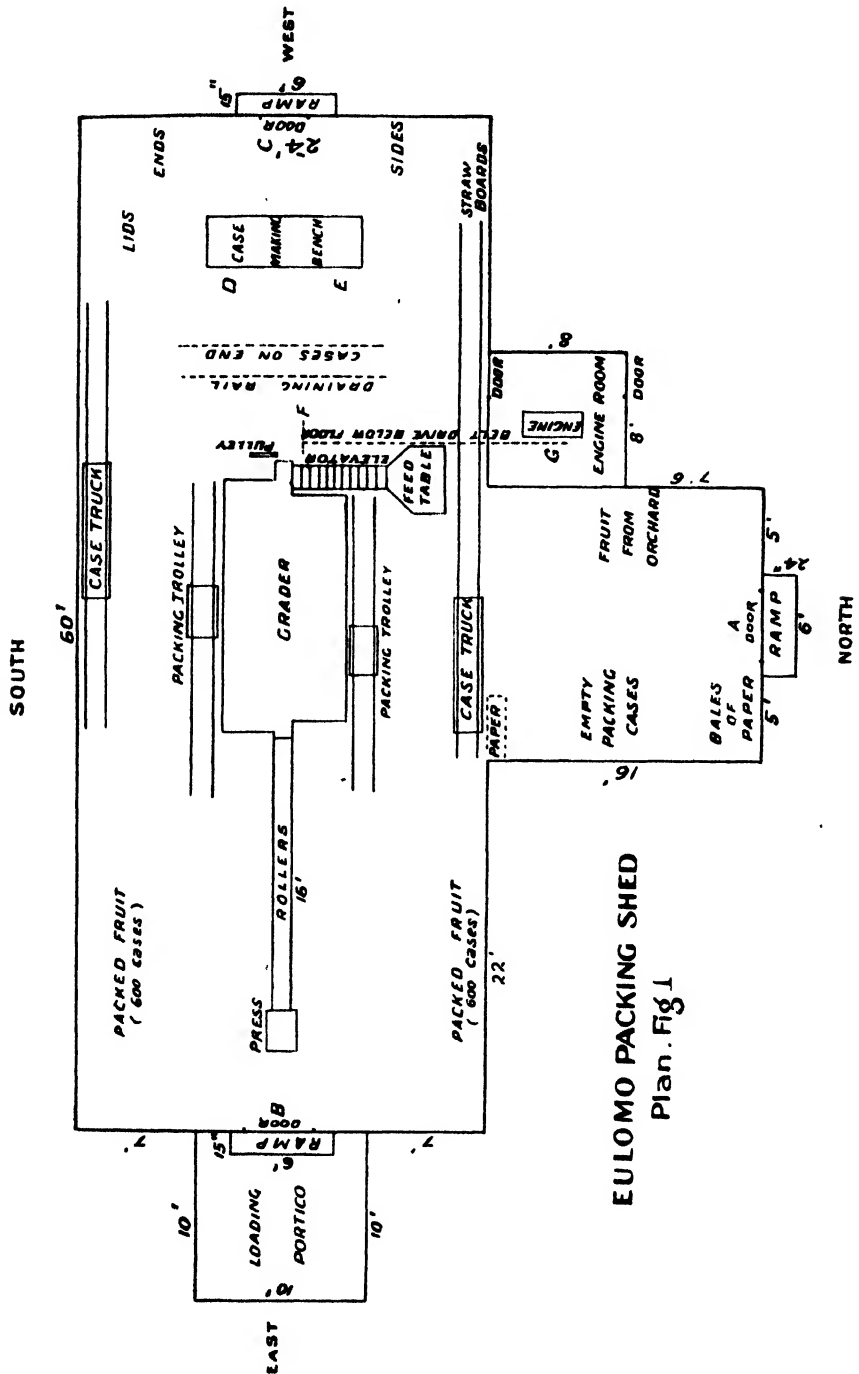
COSTS ON THE ORCHARD.

These costs can very largely be controlled by the orchardist, and may be conveniently considered under two headings:—

- (a) Production costs.
- (b) Packing costs.

PRODUCTION COSTS.

It will be at once noted that costs, grouped under headings (a) and (b) are entirely different in character. The total cost of production, or growing, is rather of a nature of an overhead expense, being dependent almost entirely on the *area* under fruit, and bearing little or no relationship to the total amount of fruit produced from that area. The cost of picking and packing is, on the other hand, almost entirely independent of the area, being governed almost entirely by the number of cases produced.



Now there are only two possible ways in which production costs can be reduced—

1. By an actual reduction in expenditure on the given area.
2. By an increase in the yield per acre, and a consequent reduction in the cost of production per case.

In most cases, costs under heading 1 have been reduced to a minimum, compatible with efficiency, and any further reduction would be followed by a corresponding diminution in yield. In fact, in some cases, an increase in the expenditure on fertiliser, sprays, etc., would be more than repaid by the greater quantity of fruit produced.

As far as costs 2 are concerned, there is probably room for improvement on most orchards. One of the chief considerations, if a high yield is to be obtained, is that each tree in the orchard shall do its share. This is far more important than the obtaining of enormous yields from certain trees or varieties. In the older orchards especially, there are many "duds," which, on account of the variety or the quality of the tree, return little profit. Such trees should be at once eliminated and replaced with better varieties, either by grafting or re-planting.

In the younger orchards this is less noticeable, and the aim should be to secure complete uniformity, as regards both the size and symmetry of the trees, in order to obtain an equal uniformity in both the yield and quality of the fruit, and thus to reduce costs to a minimum. Only by such means, can the maximum yield be obtained.

In many orchards, a considerable amount of extra cultivation might be given, with very beneficial effects, as regards the yield and quality of the fruit. On the smaller orchards, where most of the work is done by the owner, the increase in out-of-pocket expense would be negligible. In this connection, it should not be forgotten that the function of summer cultivation is not merely to conserve moisture, but, by keeping the soil aerated, to promote bacterial growth, stimulate the release of plant foods from the soil compounds, and greatly increase the fertility of the land.

A comparatively small increase in the total yield will enormously reduce the production cost *per case*, and, taken in conjunction with the savings that may be made in other directions, will go a long way towards putting the orchard on a paying basis.

COSTS ARISING FROM THE MARKETING OF SECOND GRADE FRUIT.

There is another cost, which, although it cannot actually be classed as a production cost, is an important factor in the cost of fruitgrowing, namely, costs arising from the marketing of second grade and under-sized fruit.

The marketing of these grades of fruit has always been a source of loss to orchardists. With the tightening up of the export regulations, and the consequent increase in the amount of this class of fruit available for local disposal, it has become a serious menace to the fruitgrowing industry. In conjunction with the exclusion of certain varieties from export, and the reduced purchasing power of the public, it has given rise to a local price level which, if it continue, must inevitably bring about the elimination of a number of orchardists.

Although a certain amount of attention has been devoted to this question, it does not appear to be generally recognised that the marketing of second grade and

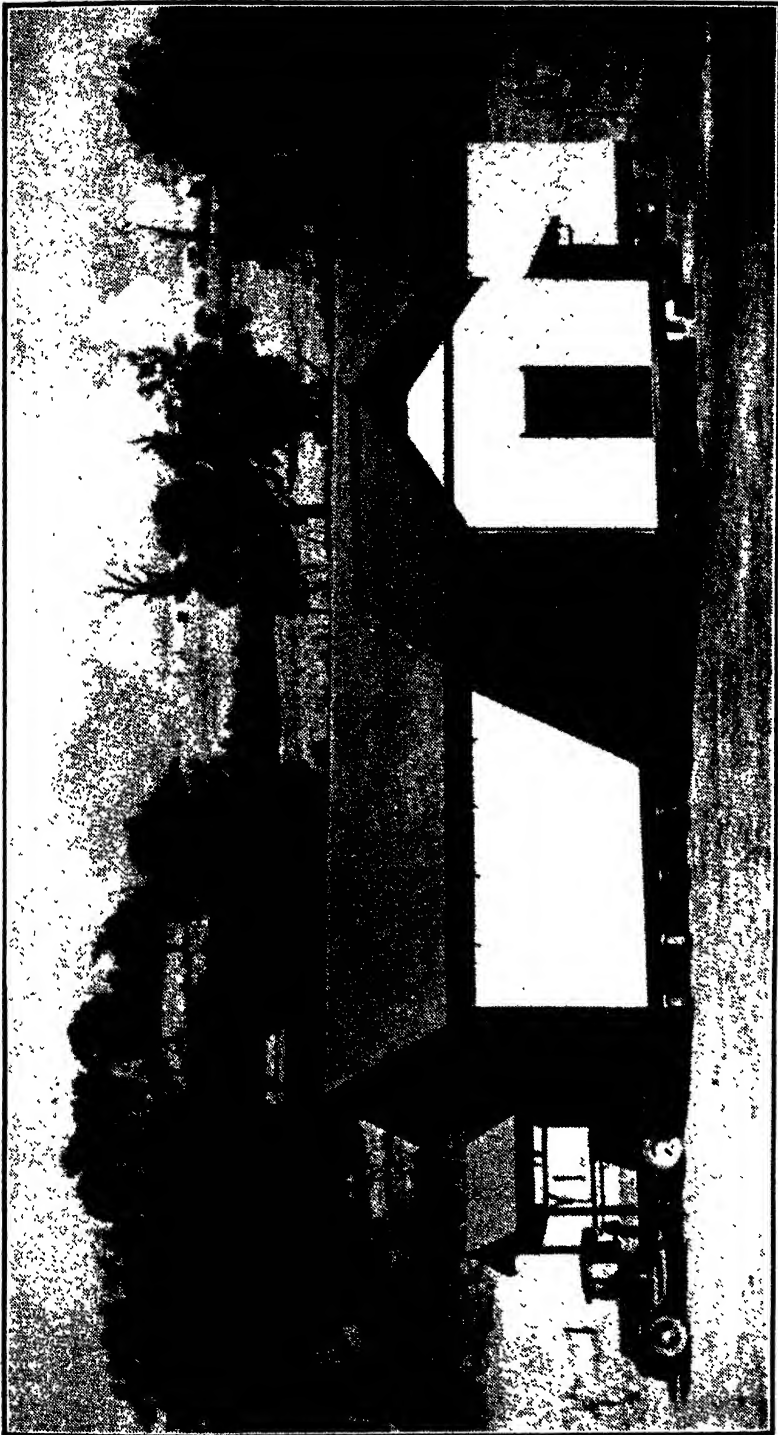


Fig. 2. --Eulomo Packing Shed (North elevation.)

under-sized fruit gives rise to what is possibly the heaviest of all individual costs—costs which are quite unnecessary—and to which may be largely attributed the unprofitable state of the industry, as far as the local market is concerned.

Consider the case of a man, who has 1000 cases for sale locally, of which 200 cases are good second grade, or under-sized fruit. There are few instances under present marketing conditions in which the returns for the latter will be sufficient to cover the cost of case, picking and packing, transport and marketing. In fact, more often than not, the net result will be a debit of perhaps 1s. per case after all these items have been taken into consideration.

If these apples had been fed to pigs or cows, if available, they would have given some return, say, sixpence a case; and if they, and all similar fruit, had been kept off the market, the average price level would have been lifted to the extent of at least 2/- per case.

The net result, therefore, of marketing the 200 cases of second grade fruit would be somewhat as follows:—

Net loss of 1/- per case, 200 c/s	£10	0	0
Loss of stock feed 6d. per c/s	5	0	0
Loss of 2/- per case on 800 c/s	80	0	0
	<hr/>		
	£95	0	0

The above figures are, of course, purely guess-work, but suffice to show the magnitude of the losses, consequent on the marketing of fruit of this class.

This loss is *partially* under the control of each orchardist, and *completely* under his control collectively. It remains for him to decide whether he will remove this disability, or allow himself to drift into bankruptcy.

PACKING COSTS.

It is in the packing and handling of fruit in the shed that there is most scope for economy on the average orchard.

Most packing sheds are made from old stables, or other buildings, which have been more or less adapted to that purpose, and are, in consequence, highly inefficient and quite unsuited to modern conditions.

The packing of fruit consists of a large number of small operations, which are repeated an indefinite number of times, and in which, to secure economy, it is necessary for a most careful examination to be made of each, since the saving of a few seconds here and there will have most far reaching effects on costs. For example, if 160 cases a day are being put through, a saving of one minute a case means a saving of 16 hours a week, which may in some instances reduce the labour which is employed by one hand. These considerations are of particular importance, in connection with the making of cases and their handling, whether full or empty. In the shed to be described, it was found possible, by a suitable re-arrangement of nails, case-parts, etc., to increase the speed of making 25 per cent., and to maintain a regular output of 30 cases per hour. It must be emphasised that this is not so much the result of quick work, as a reduction to a minimum of the distances over which case parts and cases are moved, and the elimination of all unnecessary motions.

These principles, which are well known in connection with mass production in factories, if applied to fruit packing, together with an exact synchronisation of the various phases of the process, produce most startling results, and effect savings which will in most cases pay for the cost of a new shed in a few years.

An attempt to put the above ideas into practice was made by the writer, in a shed of his own design, which was erected last season. As a result of the more convenient location of the shed and of facilities for the unloading and handling of the fruit, it was found possible to handle double the quantity with the same staff and considerably less labour.

The general arrangement of the shed will be seen from the ground plan, Fig. 1, and from the photographs, showing the north and south elevations respectively. Figs. 2 and 3. It will be noted that the shed is built in the form of a T, the principal dimensions being shown on the plan. The walls are made of asbestos sheeting, 12 feet in height, with a seven-foot gable, joints being sealed with asbestos battens. The roof is of iron, painted red, and the wood-work dark green.

The floor, which is of dressed jarrah, oiled with a mixture of equal parts kerosene and sump oil, is raised 2ft. 10in. above the ground at sliding door B, (exit for packed fruit), and door C (entrance for shooks), and 2ft. 2in. at sliding door A, where fruit enters. This brings the floor at the exact level of a lorry at doors B and C, and about 10in. below the level of a cart floor at A, thus facilitating the unloading of fruit, and the loading of empty cases. A portico, placed on the sheltered side of the building, protects the packed fruit from rain, during loading, and the unloading ramp A is built separately from the shed, and distant $\frac{1}{2}$ in. from it, in order that the jar of a cart, backed against it, may not be transmitted to the building.

The foundation posts are of split jarrah, placed at 4ft. centres, roughly squared with the broad axe, and measuring 8in. x 8in. at the bottom and 5in. x 5in. at the top, thus reducing the size of the metal ant caps, without impairing their strength, the portions in the ground being well tarred before insertion and the outside posts being oiled, where they are exposed to the weather.

In view of the very heavy loads which the floor of a packing shed is called upon to withstand, special care is necessary in the design of the floor. Shooks stacked to a height of 7 feet, if green, give rise to a pressure of about 500lbs. per square foot, while packed cases, stacked to a height of 7 feet produce a pressure of about 189lbs. per square foot. In order to make provision for these loads, the first 15 feet of the shed, from the West end, where the shooks are stacked, is provided with 8in. x 2in. bearers, 6in. x 2in. being used over the remaining portion of the shed. The floor joists are, in all cases, 4in. x 2in. placed 18in. apart, the floor boards being 6in. x 1in. dressed jarrah. Calculation shows these sizes to allow an ample factor of safety, together with absolute rigidity and freedom from vibration.

As will be seen from Fig. 1, the shooks enter at the west end of the shed, through the door C, sides, ends and lids being stacked as shown, within easy reach of the case making table. This table measures 3ft. x 9ft. by 2ft. 5in. high and carries slots for two case-makers at D and E. It stands on four legs of 6in. x 6in. jarrah, each pair of legs being connected crosswise by a piece of 8in. x 2in. jarrah, checked in $\frac{1}{2}$ in. and bolted to them. The decking consists of three pieces of 12in x 3in. jarrah, running longways, to the top of which is bolted a similar number of 12in. x 2in. jarrah, carrying slots to support the case ends, 4in. bolts with the heads countersunk below the surface of the bench, being used. Two holes are bored through the bench from the bottom of each slot, to allow sawdust to escape, and the slots are arranged in such a way that a 6in. x 6in. pair of legs comes midway between, providing an absolute solid foundation for case nailing. The case-maker, who also attends to the grader, lidding up, stencilling, stacking, etc., stands at D or E facing the door C and arranges his cases, end up, behind him. Behind this is a movable rail, on which labels are hung to drain, after being

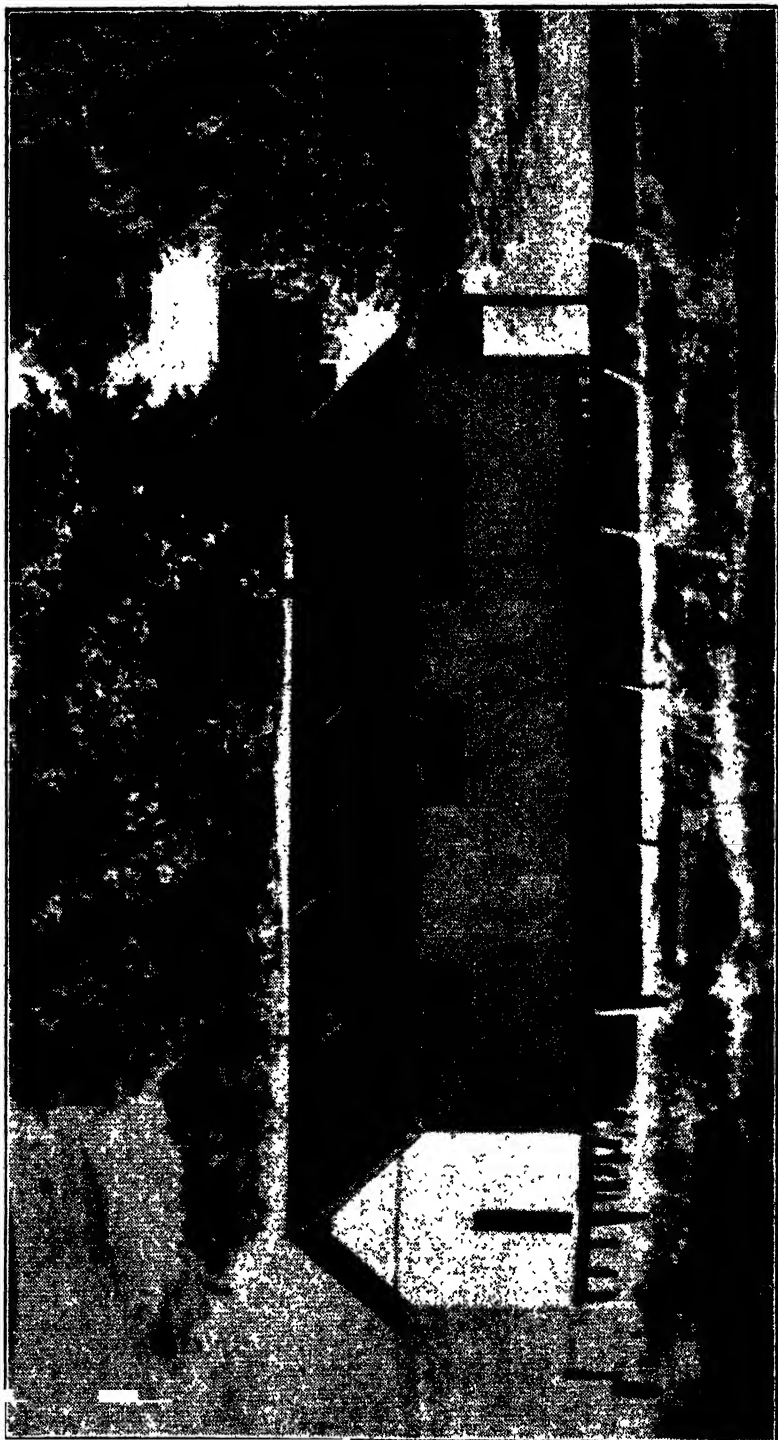


Fig. 3.—Eulomo Packing Shed. (South elevation.)

wetted. After hanging the required number of wet labels on the rail, he covers the ends of the cases with paste, and attaches them. The labelled cases are then transferred to the two case trucks Figs. 1 and 4, which run on lines, as close as possible to the walls, and which have been drawn up opposite to the line of labelled cases. The trucks are then pushed down to a position opposite to the packers. Each truck carries 24 empty cases, and on the top shelf supplies of strawboards and various sized wrapping paper are placed. The trucks are thus at all times within easy reach of the packers, a considerable saving of time resulting, as a result of the eliminating of walking to get cases or paper. The construction of the trucks, will be seen from Fig. 4, the inside dimensions being 1ft. 9½in. wide x 40in. high x 7ft. 11in. long. They run on similar wheels and axles to those supplied for packing trucks.



Fig. 4.—Case Truck.

In the centre of the shed stands a Lightning Grader, Model 21. This is fed by means of an elevator and feed table, the latter having a semi-automatic feed. The capacity of the machine is about a case a minute, the actual amount being dependent on the variety of apple and the speed at which the elevator is run. This may be stopped, or the speed varied instantly, by means of a suitable gear, without stopping the engine or altering the speed of the driving pulley, which is at all times kept constant. The speed of the grading belt may also be altered in a similar manner to suit the different varieties of apples. The grader is driven by a 2½ h.p. Wolseley engine, located in an engine room, with a concrete floor, and situated on the ground level. The belt from this drives a countershaft F. beneath the floor of the shed, and from thence, a belt passes upward, through two small holes in the floor, to the grader pulley. The countershaft is carried on posts, which are entirely separate from the building, and there is consequently a complete absence of vibration.

The installation of the above arrangement may be a matter of some difficulty. If a theodolite is available, a line should be laid out, outside the building, and parallel with the centre line of the main shed. The ends of this line should be marked by pegs driven into the ground level with the surface, in order to obviate the risk of their being moved. A similar peg should be put in this line, opposite the position of the edge of the engine pulley. Using this line as a datum line it will then be a simple matter to set out the position of the engine block, countershaft, and grader. In some cases, it will be found advantageous, instead of putting the engine direct on to the concrete block in the usual way, to bolt a sawn block of jarrah 4 inches thick to the engine bed, by means of hold-down bolts. The engine may then be attached to this by means of coach screws in any desired position, leaving a big margin for adjustment. In deciding the height of the engine foundation and the countershaft, care should be taken to allow sufficient room for the belt to clear the bedplate of the engine room walls, and the bottom of the shed bearers.

A cross-section should be drawn to scale at right angles to the length of the shed, and in the same plane as the grader pulley. In this will be shown the floor of the shed, and also the bearers, joists, and countershaft. It will then be possible to place the grader and the countershaft in such positions on the cross-section as to enable the belt to dodge the bearers and joists and also to determine the exact position of the two holes in the floor, through which the belt is to pass. In the case of this shed the centre bearer, which runs parallel to the length of the building, passes midway through the belt.

It is also a matter of considerable importance to arrange that the drive, in all cases, comes on the lower half of the belt, as otherwise the amount of slip will be greatly increased. For similar reasons the belt from the countershaft to the grader should not be vertical but should be inclined at between 45 and 60 degrees. Lack of care in the arrangement of the belts will give rise to trouble with the grader. Slip of the grading belt, or of the driving belts, tends to give rise to the bruising of fruit (which normally does not occur at all), or, if it is considerable, to the jamming of the grader.

Fruit from the orchard is brought in through sliding door A, from a cart which holds 14 cases, which, after allowing for rejects, is equivalent to from 10 to 11 packed cases. It is found that, on the average, a man and boy can pick and cart 8 loads per day. The feed table of the grader holds from 8 to 9 cases, and, if the machine is started as soon as tipping from the cart has commenced, it will be possible for the carter to tip the cases as quickly as possible, and take them back to the cart without stacking. In wet weather, a reserve of fruit can be stacked, as shown on Fig 1, sufficient to allow it to dry before packing.

The amount of fruit mentioned—from 80 to 90 cases per day—can be handled by one full-time, and one part-time packer, and as long as this amount is not exceeded for more than a day or so, all the rest of the shed work can be comfortably done by one boy. A larger amount would necessitate an additional man, to assist with the shed work and picking.

The end of the grader is connected with a Lightning Lidding-up Press, by means of a Gravity Conveyor, 16 feet in length, consisting of a series of parallel rollers, running on roller bearings, and set, together with the press, at a height of 26in above the floor. Fig. 5.

After the packing of a case is completed, the packing trolley is pushed to a point just clear of the end of the grader, and the case is lifted from it, 3ft. to the conveyor. The size of the apple is then stamped on the case with a rubber stamp, and a light push sends it to the press, into which it runs on the rollers.

When the line of rollers contains about 12 cases, strawboards and lids are put on each case, and they are run successively into the press. By pressing down the large pedal, Fig. 5, which remains in position till it is released, the lid is pressed down evenly at each end, and held down by a device, which leaves the way quite clear for nailing, nails and hammer being carried on the shelf at the back of the machine. The size and name of the apple are then stencilled on the remaining end of the case. A touch on the smaller pedal then releases the press, which rises into its original position. The case is then lifted off and stacked, in the

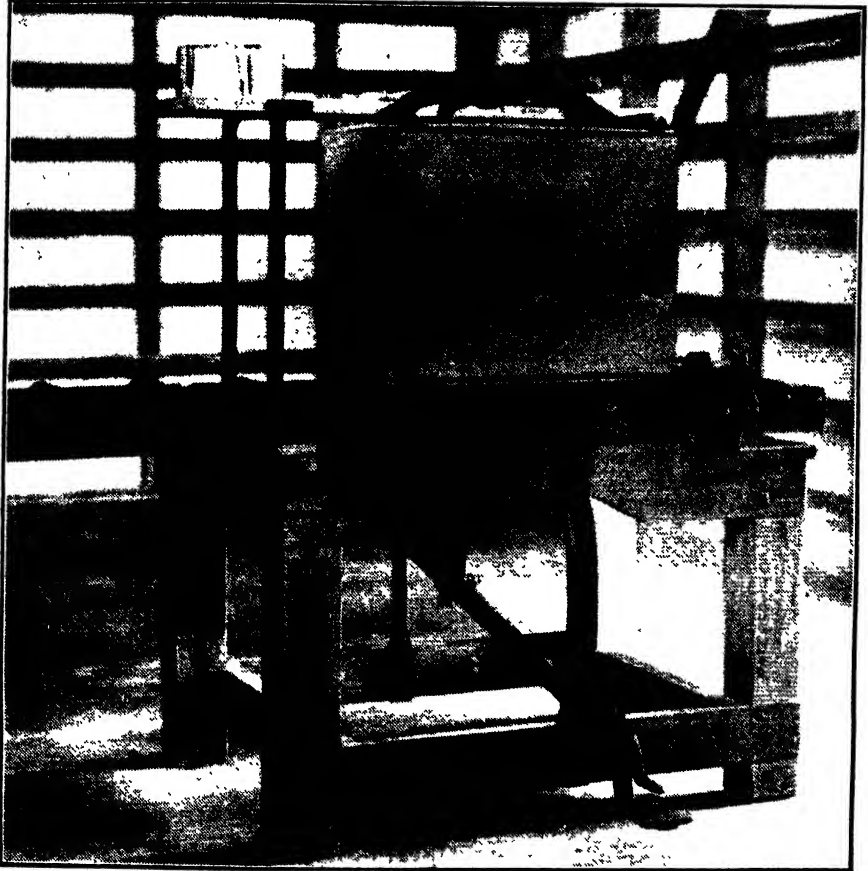


Fig. 5.—Lidding-up Press.

positions shown on Fig. 1, where there is space for 1,200 cases. It will be noted that, after having been tipped on to the grader table from the cart, the fruit has been lifted 3 feet to the conveyor, at the same level, and an average of about 12 feet to the stack.

All the above operations can be carried out without stopping, and cases may be lidded up, stencilled, and stacked comfortably at the rate of 75 per hour. A further advantage arises from the fact that the lids are pressed down evenly and gently, at both ends. They show no tendency to split, and the fruit is not forced

diagonally towards one end of the case, as when the lid is pushed down in the usual manner. It will be seen in Fig 5 that the two central rollers in the press are set at a lower level than the others, in order to allow for the bulge of the bottom of the case.

In order to protect the walls of the shed from damage from the inside, pieces of 2in. x 1in. jarrah are nailed horizontally to the inside of the studs, at 9in. centres, throughout the shed, to a height of 7 feet above the floor, Fig. 5.

It will be noted that the shed is placed with its longer axis running east and west. With the exception of the 3ft. x 2ft. and 2ft. 6in. v 2ft. windows, which light the fruit-receiving annex and the engine room, all the lighting is from the south side. Windows measuring 12ft. x 2ft., 9ft. x 2ft., and 6ft. x 2ft. are placed opposite the lidding-up press and rollers, the grader, and the case-making bench respectively, the bottom of the windows being 8 feet above the floor, Fig. 3. This lighting is supplemented by four sky-lights, set in the south slope of the roof, two being placed over the grader bins, one over the elevator, from which the rejects are picked out, and one over the case-making bench.

Since no sun ever shines on the south wall, direct sunlight never penetrates the building, and the various sources of light, aided by the reflection from the asbestos walls, produce an absolutely flat and uniform light, which casts no shadows anywhere.

It will be seen that the keynote of the whole design lies in the making of the packing a continuous process, the elimination of all unnecessary motions, unnecessary lifting and carrying, and the exact synchronisation of all sections of the process.

Experience of the results shows that in this direction lies the chief hope of a substantial reduction in the handling costs of fruitgrowing, and any grower who reorganises his operations on the above lines may look forward confidently to results which will exceed his most sanguine expectations.

FACTORS INFLUENCING THE PRODUCTION OF CLEAN MILK.

M. CULLITY, Senior Agricultural Adviser, Dairy Branch.

During the last three years, in which it was found necessary to export butter overseas, the necessity of the greatest care in the production of milk and cream by the farmer, and efficiency in handling this raw product during manufacture, with a view to the production of a product of highest quality, has been often demonstrated.

Whether engaged in the production of cream for butter making, or of milk for human consumption, this milk must be primarily of "good keeping quality," which is found to be closely correlated with low bacterial content.

The bacteriological content has reference to the numbers and kind of bacteria present. Bacteria are extremely small organisms which are invisible to the naked eye. They are everywhere, in the air, soil and water and in uncountable numbers. It is impossible to overestimate their importance. They carry out all sorts of work, often useful, *e.g.*, nitrification in soils and in the ripening of cheese. A very important work is that of ridding us of dead organic matter by the processes of fermentation and decay. While much useful work can be attributed to their action, certain kinds are the cause of various diseases which afflict the animal and plant kingdoms.

These organisms require food for existence, and depending upon the conditions under which they are found, so their rate of development varies. Under optimum conditions, as will be shown later in the section dealing with cooling, the rate of multiplication is extremely rapid.

As it happens, milk is an extremely good medium for the growth of certain kinds of bacteria, and while all of these may not be harmful to humans, their presence has a definite influence on keeping quality.

Barkworth, Mattick, Taylor and Stenhouse Williams at the Reading Institute demonstrated that according as there were a rise in bacteriological content, so there was a steady fall in the length of time the milk would keep sweet. This supports the usual measure of practice; the housewife generally judging the quality of the milk by observing whether the milk will keep for a reasonable period or whether it goes "off" or sours quickly.

Further, it was shown that when *B. Coli* was present, the deleterious effect on keeping quality was much more severe—*B. Coli* being an undesirable organism in milk, of which various types are definitely intestinal and gain access to the milk directly or indirectly from dung.

Therefore it is obvious that if milk is to keep for any reasonable period, it must be produced and treated under conditions where the numbers of bacteria gaining access and developing, are kept at a low point—that is, milk of "low-count" must be produced.

It has been repeatedly shown that the factors governing the production of milk of low count may be grouped under a small number of headings. The results obtained from Clean Milk Competitions in Wales reported by S. B. Thomas in the Welsh "Journal of Agriculture" are typical.¹ He states that a survey of the methods used show that the four chief factors in the production of clean milk are as follow:—

- (a) Sterilisation of the utensils by steam or scalding water.
- (b) Attention to details during milking.
- (c) Cooling to as low a temperature as possible immediately after milking.
- (d) The personal factor.

The more common aspects affecting the quality of the product may be treated as under:—

Atmosphere.

The atmosphere during the winter months is not a very serious contaminating feature, except where dry, dusty feeds are fed during milking or where the floor of the shed has been swept while dry prior to the commencement of milking.

In the summer months, however, the risk of contamination is greatly increased, inasmuch as dust is usually present in the air to a greater degree. The movement of the cattle in the yards creates this in large amounts, which finds its way into the milking sheds.

To reduce the possibility of contamination, it is advisable to design the buildings in such a way that a minimum of dust enters. The movements of the cows should also be studied, so that unnecessary driving is obviated.

While the sum total of the effect of atmosphere in our condition is usually not so severe as some other contaminating features, many of the types of bacteria that enter milk in this way are particularly objectionable and undesirable.

The Health of the Herd.

This has little or no influence on the total bacteriological count unless actual disease of the udder is present. In these cases, however, usually other abnormalities are present which will render the milk unfit for use.

The effect of the presence of such specific disease organisms as that responsible for tuberculosis is beyond the scope of this article.

The effect of mammitis in increasing the numbers of organisms is well shown by the following results from Wales:—

Cow.				Normal Quarter.	Inflamed Quarter.
Nancy	...	...	...	55	11,200
Sybil	...	...	...	1,450	156,000

The possibility of serious trouble with contagious mammitis is more likely where a milking machine is in use. The starting of the cows by drawing off a little fore milk is necessary to enable the operator to note whether the udder is in good order and to prepare the teats for the fixing of the teat cups.

The rejection of the fore milk should never be on to the floor of the shed, but into a bucket to be kept separate from the bulk.

The Coat of the Animal.

Contamination from this factor involves material falling into the milk during the milking process. This dirt includes manure, soil, hairs, etc., carrying organisms in considerable numbers, usually in groups which become broken up and spread throughout the milk. The greater portion of the dirt present in milk usually gains entrance from the body of the animal during milking. This may be minimised by keeping the coats in good order and by wiping the flanks and udder with a damp cloth prior to milking. The necessity for cleanliness of the teats is obvious.

Stocking of the New York Experiment Station obtained the following results, which indicate the effect of care in cleaning the cow.

Contamination of Milk by the Dirt from the Udder and Flank.

				Bacteria per C.C.		
				Total.	Acid Producing.	Liquefying.
Udder and Flank not wiped	...	...	...	7,058	3,554	81
Udder and Flank wiped	...	...	...	716	185	47
Decrease due to wiping	...	...	...	6,342	3,369	34

Milking.

The rejection of the first jets of milk from each teat means the rejection of that milk containing by far the greatest number of bacteria. While this is necessary in order to attain a high standard of production, it does seem absurd to see milkers very carefully do this and then more than nullify the good effect by some practice which results in seeding the milk with a still greater number of bacteria.

The table under gives some idea of the comparative bacteriological contents of fore milk, mid milk and strippings.²

Cow.				Fore Milk.	Mid Milk.	Strippings.
Berriers II.	...	...	...	3,040	304	574
Laura	...	...	...	310	13	455
Nancy	...	...	...	11,520	1,650	760
Betsy	...	...	...	3,780	376	210
Mabel	...	...	...	20,800	810	788
Jean	...	...	...	1,680	709	125
Average, 18 samples	...	...	...	4,805	1,329	662

That milk drawn with clean dry hands is cleaner than milk obtained by hands wet or greased with petroleum jelly or other substance has been definitely shown by Boyes and McClement of the National Institute, Reading. The results of the trials showed that no *B. Coli* was present in milk drawn with dry hands, while that drawn with greased hands was slightly better than when wet milking was practised (both systems, however, showing *B. Coli*).

The advantage of dry milking was emphasised further when the bacteriological counts were considered, the dry hand method being easily the superior, while the greased hand method was considerably better than the wet hand method.

The following table shows the results:—

BACTERIOLOGICAL COUNT.						
Method of Milking.	Number of Samples.	Bacteriological Count—Number of Samples.				
		0-1,000.	1,001-10,000.	10,001-30,000.	Over 30,000.	
Dry	30	22	6	...	2	
Wet	30	3	16	4	7	
Greasy	30	15	10	2	3	

The samples were then tested for sediment and the results tabulated, again showing the milks from best to worst in the same order, that is, dry, greasy, wet.

It is particularly necessary, therefore, to take exceptional care in preparing the cow and in the actual milking. Long hairs should be clipped from the udder, the teats must be properly cleansed and dried with clean cloths and water containing a little disinfectant, preferably a little Condy's crystal. The milker's hands must be kept in a clean condition and an ample supply of water should be on hand for washing purposes.

Milking Machines.

Machines have been the subject of several investigations, all of which tend to show the liability to the production of milk of high count (or low keeping quality) in the hands of any but very careful operators. In every case known to the writer, where a direct comparison of hand-milking and machine-milking under ordinary farm conditions has been made, the result has been against the machine. It, however, has been abundantly proved that, with careful operation, milk of low count can be produced. This is possible only where strict attention is paid to all details and efficient sterilisation is carried out. The teat cups and rubbers are usually a serious source of contamination, as has been pointed out previously.

The vacuum system—usually the most neglected part of the machine—is often responsible for the seeding of large numbers of bacteria into the milk, even where the rest of the equipment may be in faultless condition. Mattick and Proctor³ showed definitely that the vacuum system was causing considerable contamination, and they suggested improvements which were incorporated in later machines. They also showed that the milking units and their rubber components may be successfully sterilised by steam without seriously shortening the life of the rubber parts. The United States Department of Agriculture also states that the temperatures used in sterilising rubber equipment have not been more detrimental than the other methods of sterilisation.

In bucket type machines, the buckets, rubber parts, and vacuum system comprise nearly the whole of the contaminating influences. In the releaser type of machine, however, there is in addition the long overhead milk pipe, the connecting

down-pipes and the releaser apparatus. This all means additional surface over which the milk must pass and which must be sterilised before satisfactory results can be expected.

The most satisfactory method of washing machines already has been described but may be recapitulated here.⁴

1. Before milking, draw cold water through all milk tubes and the releaser so as to prevent the adhesion of milk to the pipes, etc.

2. Immediately after milking wash all dirt off the outside of the teat-cups and rubbers, then draw through each set of teat-cups sufficient cold (or preferably warm) water to flush out the milk system. When drawing the water through the set farthest from the releaser, insert a ball of horse hair in the end of the milk pipe to cause it to travel through to the releaser with the water.

3. Next draw through each set of teat-cups *not less than one gallon of boiling water* to which caustic soda has been added at the rate of *not less than 1 to 1½ tablespoonsful per 4 gallons of boiling water*. Distribute the solution as evenly as possible through each set of teat-cups.

4. Immediately follow by flushing out the caustic soda solution with 2 gallons of hot water or 1 gallon of *boiling water* for each set of teat-cups; the flushing with boiling water helps to dry the rubbers and leave the milk system dry and sweet.

5. Then remove or open the plug or flap from the releaser pipe to allow of free circulation of air.

6. Next *clean the vacuum system* in the same manner as the milk system by drawing through first the caustic soda solution and next the boiling water which has been circulated through the milk system. Pay particular attention to the cleaning of the pipe connecting the releaser to the vacuum tank, by flooding the releaser to cause the water to travel through to the vacuum tank. This is important.

7. The engine can now be stopped. *Disconnect the two long rubbers* from down-pipe and teat-cups and hang in a clean, airy place out of the sun.

8. Next disconnect the releaser, wash, rinse, and place in a clean dry sunny place, then disconnect the top or bottom half of the vacuum tank and treat in a similar manner. *To be successful these operations must be carried out daily*. This does not dispense with the necessity of dismantling the machine as often as possible so that points and crevices may be examined and treated.

The effect of using boiling water throughout the machine before milking and then cooling the machine is very efficient in reducing the count (see later, Sterilisation before use).

Washing of Utensils.

In washing utensils there are three main processes which may be summarised as under:—

1. Removal of milk film by rinsing with cold or luke warm water. Should this be neglected and hot water used directly on this film, there will result a greasiness of the parts with the ultimate formation of a scum or milk stone.

2. Cleansing in warm water containing a little soda or other cleansing agent using brushes.

3. Sterilisation.—Delayed washing, though usually thought to have little effect on the ultimate count, generally exerts a very direct influence due to the greater development of bacteria on the vessels before washing.

The trials referred to above also gave results showing the average count in milk—where utensils were washed directly after milking—to be 666,520 per cubic centimetre, while, where washing was delayed for eight hours the count was 1,677,000 per cubic centimetre.

. Sterilisation of Utensils.

The condition of the utensils exerts the greatest single influence on the bacteriological content of the milk. Improperly washed utensils exert an effect that is too obvious to need emphasis. Where washing is carried out thoroughly and sterilisation neglected, there is still a serious contamination. Prolonged heating with steam will not render utensils perfectly sterile, and it is certain that heating under the conditions usually carried out does not do the work required as effectively as the operator wishes.

To obtain as efficient sterilisation as can be wished for on a farm would necessitate the installation of a steaming compartment. This is beyond the resources of producers at the moment. But yet a simple effective method is that suggested by Proctor and Hay, of the National Institute of Reading, and previously prescribed in this Journal. This in essence is the furnishing of a small tank in which the smaller equipment may be placed and the whole put in position over a steam pipe from an ordinary boiler or copper. This system is not beyond the reach of many of the producers. The most common equipment, however, is the copper alone. In the great majority of cases this can be utilised more efficiently than is actually the case. To obtain the greatest effect the water must be boiling and the equipment placed therein for at least 15 to 20 minutes. Unfortunately, however, this procedure is not common, and what one usually sees is the splashing of hot water (usually not more than 140 degrees or 150 degrees Fah.) over the equipment. This is not sufficiently effective, and an extension of the time of exposure to heat must be made to achieve more efficient sterilisation.

Exposure for one minute to a temperature of 200 degrees Fah. is as effective as 20 to 30 minutes exposure to a temperature of 100 degrees Fah. So, naturally, if boiling water is not available, the period of immersion must be lengthened considerably. A good plan is to place all parts, sufficiently small, in the copper, and to allow them to remain there for some time.

Sterilisation of Milking Machine.

It is particularly necessary that sterilisation of the milking machine be as complete as possible. Boiling water may be used for rinsing out the pipe lines, etc., but its effect is nullified if the temperature of the pipes, etc., is such that the water is cooled to a point where its work is ineffective. Care should be exercised to see that all parts of the machine are heated to as high a temperature as is possible with boiling water or steam. A very important effect is that a self-drying degree of heat is imparted, enabling the parts to drive off all moisture, thus rendering the growth of bacteria a slower process than where moisture is present.

The following table shows the comparative effects of steam and boiling water as sterilising mediums, compared with effects where utensils were washed, but not sterilised.

Sterilisation of Utensils.	No. of Farms.	No. of Milk Samples.	Average No. of Bacteria c.c.	Per cent. Samples in which Coliform Organisms detected	Average keeping quality (days).
Efficient steam sterilisation	22	157	20,340	29	3.75
Efficient use of boiling water for sterilisation	44	308	61,000	48	3.48
Utensils washed, but not sterilised	21	158	467,000	94	1.90
Total	87	623			

The decline in keeping quality where no sterilisation was carried out is most striking.

Effect of Sterilisation Before Use.

After washing utensils are usually left for several hours before the next milking, and in that time a considerable increase in the number of bacteria occurs. Where the vessels remain wet for any reason after scalding, the growth of bacteria is more rapid than where the utensils dry out quickly.

Where a second scalding is carried out again before use, the destruction of most of the bacteria occurs, and a very improved result is obtained. This fact was demonstrated in trials carried out by the Public Health Department for the Royal Commission on the Whole Milk Supply in Perth in 1925.

Seven samples taken after passing over the cooler into a drum, after mere "cleaning" of the reservoir cooler and drums, gave the following counts:—

Total 45,000. Coli 4.

Eight samples taken after passing over the same utensils after they had been dipped in boiling water, gave the following results:—

Total 2,045. Coli 2.

Clemmer, of the United States Department of Agriculture, obtained the following actual results:—

Influence of Sterile Utensils on the Bacterial Content of Milk.

—	Utensils not Sterile.		Utensils Sterile.	
	Number of Samples.	Average No. Bacteria per c.c.	Number of Samples.	Average No. Bacteria per c.c.
Open pail	26	497,653	36	22,677
Small top pail	28	368,214	36	17,027

A similar result with milking machines was obtained by Leitch.⁵

—	Sample A.	Sample B.	Sample C.
Unit treated with hot water before milking	8,100	7,900	19,500
Unit untreated with hot water before milking	1,600,000	316,000	515,000

The results indicate that the sterilisation of the utensils immediately before use in many cases made all the difference between the production of high and low count milk.

Cooling.

The necessity for cooling the milk after it has been drawn has been emphasised in previous articles. After the milk has been obtained, this is the most important factor in restraining the development of bacteria.

The following table shows clearly the effect of temperature upon the rapidity of multiplication of bacteria and on keeping quality:—

No. of Bacteria c.c. at outset.	In 12 hours at 50 deg.	In 12 hours at 70 deg.	In 50 hours at 50 deg.	In 50 hours at 70 deg.	No. of hours before Curdling at 50 deg.	No. of hours before Curdling at 70 deg.
46,000	39,000	249,500	150,000	542,000,000	190	56
47,000	44,800	360,000	127,500	792,000,000	289	36
50,000	35,000	800,000	160,000	2,560,000,000 (42 hours)	372	42

Various types of bacteria have different temperatures at which they develop most rapidly. At the temperature at which the milk comes from the cow development of Coliform and other gas producing organisms proceeds at their maximum rate. After the next process on the ordinary farm, the water cooling, the temperature is usually reduced to the vicinity of 70°F (summer) at which temperature a different type of bacteria thrives, the lactic acid producing group, which are not considered harmful to health, but which if allowed to develop, reduce the time in which the milk will remain sweet; they cause souring. To prevent this from proceeding, where the milk has to be kept, it is necessary to reduce the temperature to a lower point, 40-50°F., where bacterial growth is comparatively slow. This can be achieved by the use of the brine cooler.

The cooling of milk to a low temperature immediately after milking is necessary in order to safeguard keeping quality. This effect may be nullified, however, if the cooler is allowed to be operated without first having been scalded. The investigations carried out by the Public Health Department in 1925 demonstrated the increase in the numbers of bacteria occurring in the passage of the milk over the cooler.

				Before Cooler.	After Cooler.
Sample 1	...	...	...	3,120	132,000
" 2	...	...	...	1,800	8,000
" 3	...	...	...	7,110	105,000
Average	...	...	...	4,010	81,666

Water Coolers are most effectively scalded by placing in a tub or copper of boiling water. The usual method of allowing hot water to run over the surface is often futile.

Brine Coolers are difficult to deal with under farm conditions as they are often too large to be placed in the usual size of boiling apparatus. The ordinary method of scalding seen is the running of a quantity of hot water over the cooler, or the throwing of buckets full of water against the surface. When one considers that the usual small brine cooler is fitted in such a way that the cold brine is still inside the pipes to be sterilised, it can readily be understood that the ordinary attempts at scalding are farcical. Actually the cold brine cools the heating medium before any scalding effect is obtained. That the brine cooler, though clean visibly, can be a serious source of contamination has been shown recently in this State during investigatory work carried out by this Department. It was demonstrated that a small brine cooler, although bright and clean on inspection, was actually seeding the milk with *B. Coli*. Actual sterilisation of this piece of equipment had never been carried out.

The provision of a by-pass or some system whereby the brine can be returned to the storage tank would facilitate scalding of the cooler itself.

Strainers of various types are in use and in many cases are doing damage to milk. The all-metal strainer is only efficient in catching the larger particles, and there is always the possibility of its gumming up, particularly at the edge. Sterilisation can only be achieved in these types by a period of boiling.

The cloth strainer should never under any circumstances be used twice without boiling and drying in the direct rays of the sun. Where the cloth is allowed to dry, as is usually the case, thrown over the cooler, or on a small line in the dairy, drying is slow and the bacterial multiplication proceeds extremely fast. The result of this is that the cloth becomes a very serious contaminating medium when again used.

The most effective type of strainer is that which uses a wad of cotton wool between two metal perforated discs. The wool is used once only and then discarded, a fresh wad being put in place at each milking. This type of strainer removes practically all visible dirt which finds its way into the milk.

Storage.

After the milk has been cooled it is necessary to provide a storage room where the temperature can be kept constant at a low point so as to prevent any great alteration in the count of the milk being held.

Transportation.

Precautions are necessary here again on the same principles as the preceding section. The temperature of the milk has to be kept as nearly as possible at a low point. This can be achieved by shortening the period of transportation, reducing the temperature to a particularly low point and using precautions to prevent heat reaching the vessels in transit. Thomas and Lewis showed that a rise of 10°F. in transit decreased the keeping quality by one day.⁶

Personal Factor.

That there is a considerable difference between the results obtained by various men working under exactly similar conditions will be accepted. Actually the personal factor may be regarded as the crux of clean milk production, as unless keenness and a desire to produce a good article is evident, the tendency is to neglect the details which means the difference between efficiency and inefficiency. Details overlooked in milking, in washing and sterilisation of utensils, in cooling, etc., nullify any advantage that may be gained by working in good premises with good equipment. It may be stated that a good operator in poor surroundings will usually produce a cleaner milk than a poor operator with good equipment.

A special study was made of the personal factor as applied to the production of milk with a low count on small farms.⁶ *The buildings and equipment were generally poor, but personal efficiency and care in the methods of production counteracted this handicap.*

That an incentive to produce clean milk by way of paying a premium has a considerable effect in concentrating attention on the details which govern low counts has been recorded by North.⁷

Influence of Various Factors on Bacterial Content of Milk.

Date.	Bacteria per c.c.	Remarks.
December 26th ...	5,500,000	Tests begun.
" 31st ...	3,000,000	
January 6th ...	1,000,000	Weather freezing.
" 13th ...	500,000	
" 29th ...	800,000	
February 12th ...	900,000	Small top pails.
March 5th ...	700,000	
" 12th ...	250,000	
" 19th ...	250,000	Pails and can sterilised.
" 26th ...	80,000	
April 2nd ...	1,000,000	Premium paid for low count.
" 9th ...	70,000	
" 16th ...	35,000	

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THE SELECTION AND TREATMENT OF BANANA PLANTS.

G. B. BARNETT,

Tropical Adviser, Department of Agriculture.

It is increasingly realised that to improve the standard of crops it is necessary to select from strong, robust, heavy and good quality producing stock. When selecting bananas for propagation not only the parentage but the progeny itself must be considered because of the all important part it plays in the ultimate success of the plantation, and with the heavy initial outlay for the grower in this State compared to other parts of the Commonwealth, it is necessary to procure the best planting material possible both to ensure early and profitable returns and enhance the disease-resisting qualities of the plantation. It will be agreed that the planting of inferior banana stock will result in the plantation producing low grade bunches and poor quality fruit, but many experienced growers do not realise the necessity for the observation of more exacting details when selecting propagation material and the early attention some types of plants require.

SUITABLE MATERIAL.

Various parts of the banana plant may be utilised for propagation purposes, such as suckers, corms, butts, bits or eyes. At the present time in this State suckers are practically the only planting material available, and it is intended that these notes should deal more especially with the selection of this particular type of planting material. Before doing so mention might be made of the usage of corms, butts and bits or eyes. The opportunity of obtaining these types of planting material is likely to be scorned by the new or inexperienced grower as being unsuitable, but good types of butts or pieces may give as good results as suckers providing they are properly handled before and after planting.

Butts are generally obtainable from old or well established plantations which have become unprofitable. There are two types of butts, viz., the one that is secured from a growing plant and the one that is taken from a plant that has produced a bunch. The former type is the more desirable as it usually produces a better first bunch. The usual custom when selling butts is to divide the butt into two or more pieces—the cutting into sections or pieces being so performed that each piece possesses one or more strong eyes. Butts may also be planted whole but it is advisable to destroy all but one or two of the strongest eyes. (The surplus eyes

can be destroyed by gouging from the corm prior to planting.) Good butts prove excellent for use as refills within the established plantation, thriving better than any other propagation material for this purpose.

When planting pieces or bits the cut surface should be turned uppermost, and therefore the eye or uncut surface will be in the bottom of the hole. Pieces usually take a little longer to come into bearing than is the case with butts. The use of eyes or bits cannot be entirely recommended for the Gascoyne district as they are liable to dry out very quickly and may possibly decay under irrigation. After subdividing the corms it is well to permit the cut surfaces to dry out a little prior to planting.

In the selection of suckers the intending grower should observe the vegetative growth, the producing qualities and the freedom from disease of the plants within the plantation from which he intends securing his plants. It is conceded that if the plantation is healthy, vigorous and producing good quality fruit the progeny should reproduce on similar lines.

Generally speaking the average plantation is considered to be in its prime between the age of three to six years, but it is suggested that growers take this as a guide only, for some plantations of less mature age may more than favourably compare with plantations between the ages mentioned.

ONE-YEAR-OLD STOOLS.

The selection of suckers from one-year-old plantations is much to be discouraged, not only because of the inferior quality planting material available (figs. 1-3) but the damage that may be done to the parent plant bearing or about to throw its bunch. Suckers selected from year-old plants cannot be expected to compare with suckers from a three-year-old stool (fig. 2), as the year-old plant must necessarily be producing offspring of tender growth which are only good quality plants in the making. No doubt there are exceptions, but when the damage likely to occur to the parent by the removal of suitable planting material is considered the wise grower will realise that the saving in the cost of plants or the money gained by the sale of such suckers will not recompense him for the damage to the young parent and developing bunch. The sucker being tender is likely to give poor planting results should adverse weather conditions be experienced, but should the grower find it necessary to use such material in establishing his plantation he should arrange for the planting to be carried out as quickly as possible after the removal of the sucker from the parent plant. Additional care should be taken during the removal of the sucker from the parent, both from the viewpoint of the young parent and tender offshoot.

Fig. 1 depicts six suckers taken from a one-year-old plantation, and only B and C are fairly suitable plants for propagation purposes. Note the area that had to be severed from the side of the parent to permit the removal of suckers A and B.

Taking the well developed plantation as the grower's best guide, the best type of sucker to select must be considered. Opinions vary even amongst experienced growers as to the stage suckers should reach before removal for transplanting. The fact is generally acknowledged that the later in the spring suckers are removed the better, but it must not be forgotten that the plant or sucker planted late may have to commence its new life under rather severe climatic conditions on the Gascoyne. Suckers six to eight months old are favoured by some growers, their method being to eliminate the centre growth and allow the first followers to produce the first bunch. When using this type of plant, if this practice is not adopted the grower may anticipate an early bunch of rather inferior fruit compared to the bunch that would be carried by the first follower were the original centre growth destroyed.

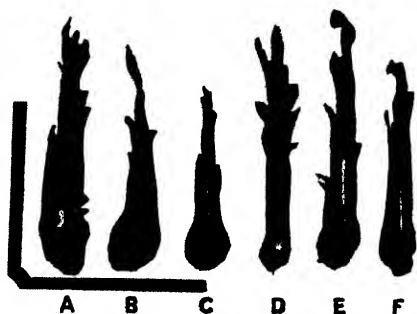


Fig. 1.



Fig. 2.

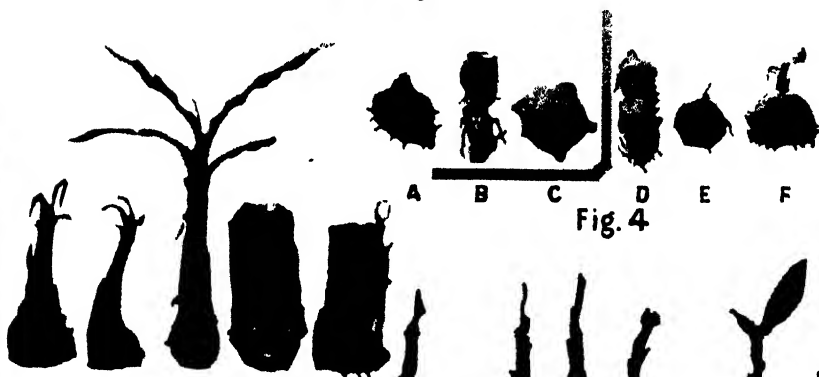


Fig. 3.

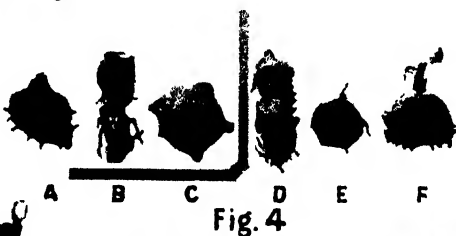


Fig. 4.

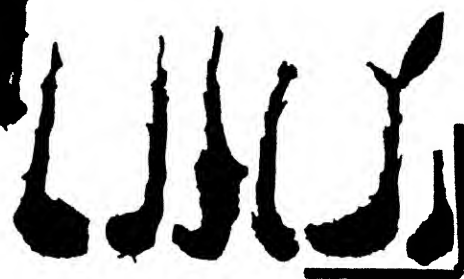


Fig. 5.

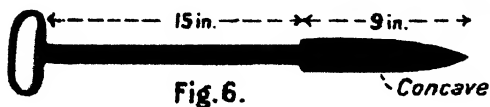


Fig. 6.

- (1) Typical type suckers from an average 1-year-old plantation. B & C are good type suckers in the making. Compare these plants with those in Fig. 2.
- (2) Spear point or sword suckers from 3-year-old stools. Note the bulbs and tapering barrels compared to suckers depicted in Fig. 1.
- (3) Suckers from a very vigorous 1-year-old plantation dug late in the planting season. Suitable for planting if given suggested additional treatment.
- (4) Propagation material from a run-out or declining plantation. Such material should never be used. F is typical onion bulb.
- (5) Another group of inferior type plants usually obtained from a declining plantation. Such material should be strictly avoided.

The size of the sucker is not a true guide to quality for the rapidity of growth of suckers varies tremendously. The main points to keep in mind are that plants should possess good solid bulb formation with the pseudostem or barrel of the plant tapering from the bulb to the apex, the leaves growing fairly upright being small and narrow; such type suckers are commonly known as "spear points" or "sword" suckers. Strictly avoid suckers with small bulbs possessing barrels of more or less even girth from bulb to apex, with broad spreading leaves. These are known as "umbrella" or "water" suckers and are slow developing plants producing inferior bunches. Fig. 2 describes good type spear points or sword suckers removed from three-year-old stools and are far superior to all suckers in Fig. 1.

REMOVING THE SUCKER.

The utmost care should be taken during the operation of removing the sucker from the stool both for the good of the sucker and parent plant. The mattock, shovel or hoe are not very satisfactory tools for severing the sucker, and the operator should use a suitable bar, similar to a crowbar, the blade of which should be long, flat and wide and possessed of a sharp edge. For convenience of working the blade portion of the bar may be set at an angle to the main shaft of the instrument, the whole implement being of sufficient weight to give a good fall.

The soil should be removed from between the parent plant and sucker so that the operator can detect the union of the two plants. The bar is then placed at the narrowest part of the union and forced downwards. With large suckers it is necessary to remove soil from both sides before attempting the removal, and it may be found necessary to aim the bar at the point of union of the two plants. Never attempt to remove plants that are wedged between two adult plants, for not only is the young plant likely to be damaged, but considerable root surface on the adult plants will be destroyed. The entire operation should be one of gentleness—no more force than necessary should be used when loosening the sucker. With the most careful and methodical operator there is likely to be a percentage of damaged suckers and these should be discarded. The honest vendor will not supply damaged or otherwise unsuitable plants that he himself would not plant.

AFTER REMOVAL.

All leaves should be removed to minimise transpiration and all roots cut off close to the bulb or corm. With large plants it is advisable to cut back the top portion of the barrel to within about eight inches of the crown of the bulb in preference to only removing the leaves. The cut should be made on the slant and high enough up on the stem so that when the sucker is planted the irrigation water will not cover the cut surface (this point relates more particularly to late planting). Where suckers as depicted in Fig. 2 are being used as planting material it is optional to remove any of the top growth. As a precaution against fungal infection of the sucker after removal from the stool the cut surface of the plant may be turned to the sunlight for several days when the sappy surface will harden and thus reduce the possibility of corm trouble. This precautionary measure should also be adopted with cut up butts but is not recommended in the case of suckers from year-old plants. The habit of certain growers of rubbing the freshly cut surface of the sucker or bits in the soil is a bad one, as this action is liable to introduce soil fungi and bacteria which may mean decay of the corm early in the life of the young plant.

All propagation material should be free of all soil and roots prior to removal to the intended planting ground. This precaution is necessary so that disease and pests which harbour in and about the corm may be detected.

DE-SUCKERING.

The pruning or reducing of surplus sucker growth from around the plant or stool is necessary if large marketable bunches of fruit are required. With this object in view the grower must formulate some method whereby this work can be carried out most efficiently. The entire digging out of the surplus suckers is not recommended as to do so necessitates the destruction or damage of much root surface on the remaining plants which naturally must have a detrimental effect on the forthcoming bunch. The work can be most successfully carried out by the use of what is termed a "banana gouge" or "de-suckering bar" (Fig. 6). By the use of this implement the growing point of surplus suckers can be destroyed without in any way disturbing the root system of the parent plant. This operation is best or most easily carried out when the surplus suckers are about one foot high; if the suckers are allowed to develop to a more mature age the work of de-suckering is increased and in the meantime unnecessary sapping of plant food is occurring.

The plant to be removed should be cut off at ground level with a sharp knife. The point of the gouge is then inserted just inside the outer edge of the base of the plant and with a little pressure and turning of the handle in an auger-like fashion the heart of the corm or bulb can be lifted out. The heart of the corm can be detected by the close white-grained tissue compared with the other parts of the corm. Until the operator has become accustomed to detecting the heart section it is suggested that he gouge right through the corm into the soil, when he will be satisfied that the vital portion has been destroyed.

The number of suckers that should be left around a stool depends upon such factors as the age and condition of the plantation, distance apart of stools, soil conditions, etc. In the case of a year-old stool no more than three followers of various ages should be allowed, and these should be so located that each one is as far apart as possible around the stool. In the regulation of suckers around a well developed stool, the main object should be to select offshoots of varying age so that not all plants are maturing their bunches at the same time. Three adult plants with three followers is quite sufficient growth to allow to remain if large bunches are required. Eliminate suckers that develop between the adult plants or in the centre of the stool as these suckers will seldom produce commercial bunches. The type of offshoot to leave can be selected on the same points that have already been mentioned when selecting propagation material.

THE MEDITERRANEAN FRUIT FLY.

(*Ceratitis Capitata*.)

By L. J. NEWMAN, F.R.E.S., Government Entomologist.

The fruit fly during the last fruit season assumed plague form, being more numerous and widespread than ever before. A feature of last year was the increased attack on fruits which are normally only more or less accidentally invaded. There were factors which appeared to favour the increase of the pest, namely the very high humidity of the last summer and the advent of exceptionally early and copious autumn rains. These early rains appeared to not only favour the fly, but predisposed fruits to attack which normally are not regarded as suitable breeding hosts.

The fly was carried on in large numbers until the end of May. Although the winter has been a wet one, in the fly areas there has been a very active carry-over of the fly to September. These flies, together with those now emerging from pupae, derived from maggots which have fallen from citrus and loquats since May, are now, upon the advent of warmer weather, becoming active and are reproducing in ripe citrus and loquats.

Unfortunately, the general fruit-growing public have regarded this insect as being only active during the warmer periods of the year, and when the month of May is over, they regard the fruit fly season as ended, and with a sigh of relief decide that there is no need for further action until fly-infested fruit becomes plentiful in December. It has frequently been pointed out both by lectures, bulletins and press notices, that there is no month of the year under our climatic conditions that the fruit fly is not active; many tests to prove this statement have been carried out and the results published.

The life cycle of the fruit fly is certainly more rapid during the warmer months, but, nevertheless, we must recognise the fact that this pest is with us all the year round. Until the fruit-growing public do act upon this established fact and take the necessary action we shall never bring this very virulent pest under economic control. What is desired, is that the public should clearly understand that there is one time when it is easiest to effectively cope with any given pest. It is much better to attack it at the most vulnerable period of its life, than to wait until all the factors are favourable to the insect, such as the warmer summer period, with its abundance of available host fruits, provides the fruit fly.

As illustrations of the life cycle of the fruit fly during winter and spring, the following definitely proved examples of how this pest negotiates this period, are herewith given.

An egg deposited on the 1st of June could hatch, taking maximum periods, on the 20th June (20 days). The larva or maggot could pupate on the 4th of August (45 days maggot stage) and emerge as a fly on the 24th of September (50 days' pupation). Allowing 70 days as the average life of the adult fly, she would live and be able to function until the beginning of December, making a total life cycle, from the laying of the egg to the death of fly, six months.

Taking a second illustration. A larva or maggot pupating on the 1st June could issue as a fly on the 15th July (45 days) and live as a functioning fly until the 24th September. In each instance, if a fruit medium is not available or the weather is not sufficiently warm to stimulate egg laying, these flies can extend their life period up to 117 days.

The male flies do not live as long as the females, and hence in trapping during the winter and early spring the bulk of the flies captured are pregnant females. Fortunately few eggs are laid in citrus after the end of May, as the weather then becomes too cold. Every now and then, however, throughout this period, warm bright days do occur, and some eggs are deposited. The actual loss by fruit fly from June to November is comparatively of little economic importance.

In the case of citrus fruits, the eggs are frequently destroyed by the oil which exudes from the wound made by the insertion of the ovipositor. The oil flows or spreads over the eggs and varnishes them thus causing them to shrivel and die. Eggs laid into unripe citrus seldom develop maggots. As the fruit ripens, the skin gets thinner, thus permitting the eggs to be deposited in the flesh of the ripe fruit. In such cases the eggs will hatch and the maggots develop. Probably not

more than 1 per cent. of winter and spring citrus fruits carry the larva of the fruit fly to maturity. Many fruits may be struck and exhibit the typical mark, commonly known as the sting.

Loquats in like manner are not heavily infested. The one per cent. of fruit in the winter which has harboured the larvae of the fly, gives rise to the early spring flies of both sexes, which supplement those that have carried through as adults.

As soon as the weather warms up in late August, or early September, the flies which have survived the winter become active, and, if not destroyed, become the progenitors of the myriads which ravage our fruits in the summer. When it is realised that each female fly is capable of laying 300 eggs and that every 34 days during the summer (mid November to mid April) this fly completes its life cycle from egg to adult, the benefit of capturing the Winter and Spring generations is surely most obvious.

Growers should be more enthusiastic about the capture of the few flies in the off season than they are about the thousands caught later in the summer, realising that the ones and twos are the progenitors of the future swarms. The capture of large numbers in the summer might be likened to an attempt to bail out the Swan River. Immense quantities of water may be removed with little apparent reduction, and so it is with the fly; large numbers may be trapped or destroyed and still myriads remain to carry on the work of fruit destruction.

It is not here suggested that no efforts be made to capture or destroy the fly in the summer, but that the best time to make an effective check upon the pest is during the winter and spring.

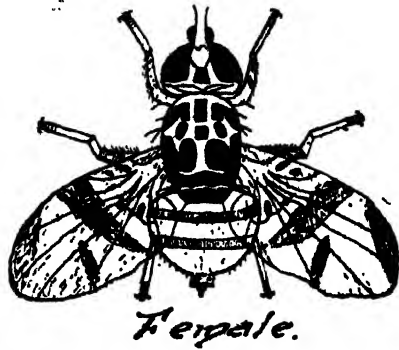
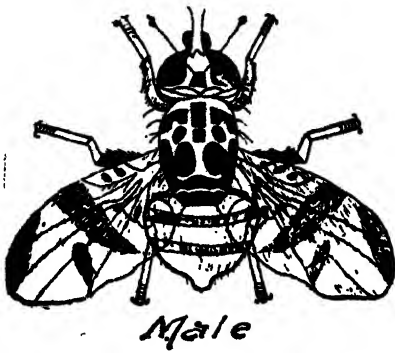
The citrus and loquat trees are the chief medium by means of which the fly is carried over from autumn to early summer. The shelter offered by the dense foliage gives protection against the elements. The odour emanating from the fruits causes the flies to concentrate there as the deciduous fruits cease to exist and the foliage falls. Further, citrus trees are very often infested with scale and aphids. The honeydew secreted or given off by these sap sucking insects is readily consumed by the fly and constitutes an effective food supply. The fact that the flies are so concentrated in these trees, gives the great opportunity to capture or poison them off. The fact that little loss occurs during this period is the cause of the lack of effort made by the grower to take advantage of this weakness.

It is absolutely necessary, in the interests of the fruit industry, that the general apathy towards the fruit fly be broken down and the public enthused with the knowledge that this pest, if attacked co-operatively, at the right time, can be brought below the danger line.

Life Stages.

The adult fly is two-winged, about the same size as the common house fly, and of the same general shape, except that the abdomen is slightly broader and in the case of the female distinctly pointed. In colour it is ochreous yellow, the back being marked with an irregular mosaic pattern. The wings, which are carried in a drooping position, are semi-transparent, marked with three irregular yellowish-brown blotches. The abdomen is hairy and marked with two broad silvery or light purplish bands on a yellow background. The legs are six in number and yellow. The eyes are large and in colour purplish red. On the head of the male are to be seen two extra spatulated appendages or horns, and the tip of the abdomen is much

less pointed than that of the female. The eggs are pure white, elongated and slightly curved and are laid into the fruit, not the flower, in batches of 6 to 14.



Fruit Fly:
Ceratitis Capitata: (Weid.)
x 8 Times.

Life stages of fruit fly (original).



Imago or Adult, natural size.

The fully developed maggots are about one-third inch long, white to creamy white in colour, with small black hook-like jaws, with which they rend the cells of the fruit and make available the juice upon which they live. The maggot, by

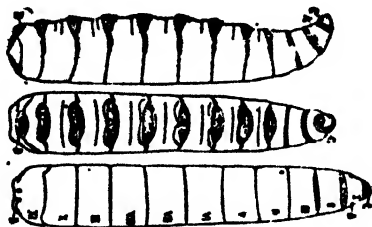


Maggot, Natural Size.



Maggot enlarged 2 1/2 times.

arching up its body, drawing the tip down to the head, can with a sudden muscular action jump a distance of 18 inches. The maggot of the Ferment fly often found

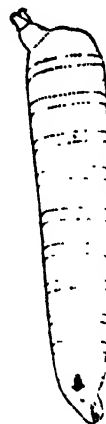


Outline of Maggot greatly enlarged, showing dorsal, ventral, and side view; also number of body segments.

in fruit which has been damaged or is in a state of decay, cannot jump, and, instead of being truncated or blunt at the posterior end, has the breathing spiracles situated on a tail-like protuberance.



Pupae and Larvae of Ferment Fly.

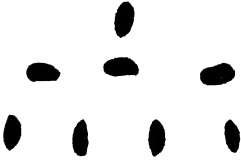


Outline of Ferment Fly Larva, showing breathing spiracles.



Adult Ferment Fly.

The pupa of the fruit fly is formed by the contracting and drying of the chitinous skin of the maggot into a small oval parchment-like case of a golden-brown colour. It is usually found in the soil, or under rubbish and litter, or at times is found in the corners of cases or other fruit containers.



Pupae of Fruit-fly.



Fruit-fly emerging from Pupa.



Glass Cylinder containing 500,000 Fruit-fly Pupae sieved from soil of neglected orchard.

CONTROL MEASURES.

First and foremost gather daily all infested fruits from trees and ground, and destroy by steeping in boiling water for five to 10 minutes. Every fruit laid

into, is a trapping medium, if such fruit is destroyed. This, if done systematically and co-operatively would, in itself, deal an effective blow to the fruit fly. Infested fruit may be destroyed by placing same in barrels containing water and a film of kerosene. The fruit would need to remain submerged for at least three days, when it can be disposed of by burying.

In careful tests made it was found that at least 72 hours submersion was required to destroy all the maggots. Barrels or drums may be placed at intervals in the orchard, the infested fruits collected and placed therein, and kept covered with water and oil.

BURYING OF INFESTED FRUITS.

If this method is employed, although not recommended, it is necessary to see that the fruit is covered with at least 15 to 18 inches of well-compacted soil. Infested fruit covered with less depth of soil forms ideal pupation conditions for the maggots, and is little better than if it were never picked up.

STORAGE ROOMS OR CELLARS.

These should be fitted with spring wire doors and screened windows. The storage of infested fruits is common. The eggs hatch in storage, and finally the larvae pupate in the crevices and about the floor and emerge later as flies. These flies escape again to the orchard, and thus, to a great extent, nullify the advantage of the daily pick-up of infested fruit.

Having done all possible along the first line of attack, namely, the daily destruction of all infested fruits, trapping and foliage baiting must be undertaken. In areas up to 200 trees trapping or luring with approved lures is advised. In larger orchards traps are used as indicators, and when the fly is discovered in the traps advantage should be taken of the first fine or suitable weather to apply the foliage bait. For further information concerning the making of the foliage bait and the composition of the luring or trapping mediums, see Leaflet No. 403, obtainable from the Department of Agriculture.

In conclusion, I would point out that the secret of success against this pest depends largely upon all making themselves acquainted with the habits and times of appearance of the fly, and to have a working knowledge of the preventive and control practices. In nature we have an energetic and ever wakeful taskmaster, who demands a fully alive pupil.

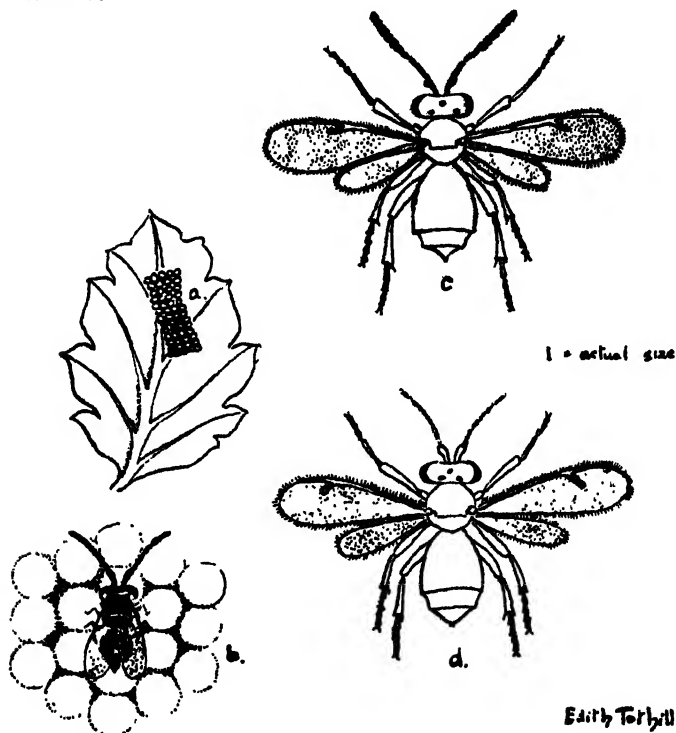
Co-operation of all concerned is absolutely essential if we are to conquer this most virile and destructive fruit pest.

THE GREEN TOMATO BUG EGG PARASITE.

(*Microphamurus megacephalus*.)

L. J. NEWMAN, F.R.E.S.,
Government Entomologist.

Last year the Department were successful in introducing this parasite from Egypt. A large number were bred and distributed to all parts of the South-West. Definite evidence was forthcoming, which showed that the parasite had reproduced in the field.



Microphamurus
megacephalus, Ashmead

- (a) Egg raft (natural size)
- (b) Parasite attacking eggs (enlarged)
- (c) Female (multiplied by 15)
- (d) Male " " "

As there was some doubt as to whether this wasp would negotiate our winter successfully in the field, a number of the wasps have been carried over in the insectary. An appeal is now being made requesting that growers will make every effort to forward as soon as possible any rafts of bug eggs they can find to the Entomologist, Department of Agriculture. The eggs are usually found on the backs of leaves of the plants attacked, and to be of use for the breeding of the parasite must be creamy-yellow in colour. If they have turned pink they are too advanced, and should be destroyed. If turning black leave them alone, as they are probably carrying the parasite.

The eggs supplied will be submitted to the parasite, and a proportion of them returned to the grower with full instructions how to place them.

POULTRY FARMING FOR THE BEGINNER.

G. D. SHAW,

Poultry Adviser, Department of Agriculture.

Poultry farming in Western Australia is increasing both as regards the number following it as an occupation and in egg value. Unemployment has forced numbers to embark on the production of eggs for profit so that within the ranks of the poultry farmers to-day are many who have little chance of success unless guided along the right methods of management.

To be successful in any industry means the continued study of that industry. At present, popular opinion is not above referring to poultry farming as only a "stop-gap"—something to fill in the time until other employment is available. During the last five years, poultry farming has increased in value to the State until to-day it stands very high in the list of primary industries. It has been one of the very few industries which have paid their way, so much so that it contains many farmers who are sure to meet with disaster unless the subject is studied closely.

The old established poultry farmer knows of the pitfalls liable to trouble the beginner. It is the beginner who needs the elementary advice in order to assist him to success, and to this end the present article is written.

The successful poultry farmers of to-day are, in the main, men and women who were owners or fanciers of a few fowls on a suburban allotment. They desired an extension of their hobby and invested in a small farm, built it up gradually while still working at their daily occupation and finally branched out into full-time poultry farming. They studied their subject and realised it is a highly technical occupation.

Unfortunately the period of unemployment caused many to scan the columns of the daily papers, select a picturesque advertisement and negotiate a purchase on the nominal deposit system and easy instalments with apparently no interest. In numerous cases the purchasers had no idea of the pitfalls confronting them and were obliged to sell out to others who would again follow in their footsteps.

Before embarking in poultry farming, one should serve an apprenticeship on a well-conducted farm or have had experience in the backyard. Poultry handled in small units presents few troubles but when handled in large numbers is a difficult problem for the beginner.

The first essential to poultry farming is the appreciation of the worth of a fowl, meaning, of course, whether one delights in the occupation. If you have no love for the birds, the industry is well left alone. One must be a constant admirer of the stock and study its management.

LOCATION.

Any soil of a light nature is suitable for poultry farming. Good drainage is of first importance and marketing facilities must be considered. Locate the proposed farm as near as possible to the best market, consider the condition of the roads carrying the transport and be sure there is an abundance of cheap water. Poultry farms located near the big markets have the advantage of cheap, quick transport with roads generally better in the more settled districts. The nearer the market the fresher the eggs should be on arrival.

SOIL.

The soil required in a poultry run need not be of the best. In fact, the poorer the soil the better the natural drainage and the cleaner the yards. Heavy soils have a tendency to foul very easily, while sandy soils filter the filth after each heavy

shower of rain. Coastal sand is the best, providing facilities are available for the growth of green feed in sufficient quantities. As much care and judgment should be exercised in choosing land for a poultry farm as for any other purpose.

When selecting a site, the poultryman must have a clear idea of how he is going to handle his stock, and plan accordingly.

STARTING.

There are two methods of starting—(1) to buy a going concern; (2) to build up from a virgin block.

(1) Poultry farms are on the market for various reasons. Only in isolated cases have the sellers a reasonable excuse, such as old age, sickness, or selling out because of having made enough in order to retire. We do hear of the latter, but more often of the former. One can examine these propositions with an open mind. Plenty of money is required to buy out either proposition as these farms are valuable. Most farms are on the market because the farm is unprofitable. That fact is not broadcast yet a casual glance at the purchase price and the deposit required will give a fair idea of the owner's value of his stock. Who is going to sell 500 laying fowls with all appurtenances for £50 deposit when a good average bird is worth at least 7s. 6d.? Yet these propositions are sold by the dozens to the sorrow of the purchasers, through the ultimate loss of their hard-earned savings.

At times a reasonable figure is desired, one which allows of plenty of cash left over after the deposit. The balance can then be applied in stocking and feeding to productivity.

(2) When starting on a virgin situation the position is one of self endeavour. One has no buildings to re-arrange to suit one's particular design, and advice from an efficient poultry farmer can always be procured in order to dodge the pitfalls. Correct design is applied and the farm built up on a well thought out plan of progress. Plan slowly. Many have ordered chickens before the sheds are ready. They have not given a thought to green feed, let alone water supply, and casually send £50 away for the chickens—receive them and then find that the housing is not ready.

The sensible man can estimate that it will take time for water, green-feed and shedding to be established. He starts to arrange well ahead, perhaps 12 months before, so that when the rearing season comes along he has no rushed jobs. All he has to do is to feed and comfort his stock. He has studied his occupation and if he keeps going along those same lines he is a successful man, called "lucky" by the persons who failed. The poultry farmer must be a student of his occupation.

LAYOUT.

The student now starts poultry farming by building his farm on a virgin block or one that has no poultry buildings at present erected.

The first essential is a good water supply. Water is 90 per cent. of the farm's requirements. It is certainly No. 1 job.

Make the farm justify the residence. It is of no use having a £800 house if the stock cannot earn enough to justify the expenditure. Better to spend £200 only and put the rest into sheds and stock.

A brooder shed is *not* required. Under to-day's best practices the fowl shed is a thing of beauty and good management. It is the bedroom, dining room, drawing room and workshop all in one, not costly but certainly cosy. Designs are many and more or less efficient. Build one having the above attributes and it is excellent in which to brood the chicks. Add to it each year and brood the chicks in each new addition until you have sufficient housing for a self contained farm. The natural deaths and culling will then give plenty of idle space in February to June and then

brood the new chicks in that idle space. By this means the capital cost has been kept in use all through the year, whereas a brooder shed keeps capital idle from September to the following June. No banker would do that.

Dig and manure the lucerne patch in readiness. The water supply being assured get the grass going as soon as possible. As the lucerne lasts years it is worth preparing properly.

Build breeding pens and incubator shed for future use. How convenient then to receive the chicks knowing that sufficient shedding is completed without crushing. Time is available to concentrate on studying the stock and its progress.

Concentration to analyse the pros and cons of any article read makes for success. Many a fool may drop a gem of wisdom but it is the wise man who picks up that gem. Realise that we ourselves do not know the A to Z of poultry farming—the other fellow has part of the alphabet contained in his head.

Previously it has been stressed that stock is of foremost importance; it is; but running side by side is management. The best of stock is ruined by mismanagement, and the worst of stock cannot pay its way even with the best of management.

BREEDS.

What is the best breed of fowl? A question asked by many seeking advice when starting. One should never consider a breed as the best. The newcomer should consider which breed he admires best, buy the best of that breed to start with, and he will surely succeed.

Egg-laying competitions help the newcomer to ascertain who are the breeders of the particular breed he desires. These breeders advertise their birds as *their own* strain. Look down the advertisements in the Poultry Sales column of the local papers. It is noticed that you can buy White Lodge cockerels at 5s. from Mrs. "Blank," Subiaco. It is quite obvious that White Lodge cockerels were never bred by Mrs. Blank. This lady is selling under false pretences but the uninitiated falls. It should be understood that White Lodge strain is one of the best in Australia, but because a White Lodge cockerel was imported into a farm two or three years ago that does not justify the breeder in calling the progeny White Lodge strain. They certainly have that particular blood in their bodies but its virtues may have been ruined by the recent matings. Our breeders who advertise their stock as their own strain are reliable inasmuch as they are students of breeding and are proud of their poultry progeny. Once the bird has left the breeder the strain as a strain should be lost.

One can never buy pullets and laying hens at 4s. to 6s. per pair from a good poultry farm. One can buy plenty of culls at that price anywhere, especially from dealers, who will tell you all about "an old man poultry farmer who is selling out owing to sickness." A good hen is worth 10s. 6d. to-day, and a pullet more. There are cockerels for sale at 5s. and 7s. 6d., but what student of poultry farming would be prepared to spend years of study in the industry, trapnest, single mate, and then feed cockerels to 10 months, in order to be a Good Samaritan by selling the product of his brains for 5s.? No one. Be prepared to pay from 21s. to 42s. for a good cockerel from a reliable breeder. You are buying his brains and it will be well worth the money. The same applies to chickens. Buy only from those advertising their own strain and are proud of it.

FEED.

It is not necessary to buy the most expensive feed, but buy the best of everything. By good management it is found that the simpler the feed the better the stock. We have cure-alls for sickness and spices for making birds lay an egg a day.

Such statements are ridiculous; it is necessary to give tonics at certain periods but not all the time. If it is necessary to tonic all the time look for bad management. Western Australia has an abundance of water, green-feed, wheat, meat and sunshine, and mixtures made from those ingredients will generally result in good production.

PLANT.

You must have efficient plant but do not let a salesman sell you something you do not want. Study will again prove that if you are going to build up a 1,000-head farm a 6,000-egg incubator is not wanted. Start smaller and learn by practical experience how to operate an incubator suiting your requirements.

Always realise that a brooder will never cover the number of chicks it is said to hold. Allow only 75 per cent. capacity.

Plenty of feed and water troughs so that all young stock can feed at one and the same time are necessary. With a shortage of food and water troughs the modest lady is always left—does not grow and is unprofitable.

Chaffcutters of all sizes can be purchased. It is little use obtaining one which takes an hour to cut up the feed for one hundred fowls. Obtain one which will do the cutting quickly when you have 1,000. The difference in cost is very little and saves time.

Having given a rough outline of the troubles of the newcomer into poultry farming, it is my idea to try and give ideas in order to smooth the path. You will have noticed that I do not like to buy a "going concern." To do that the purchaser must be well equipped with the knowledge of poultry farming. For any but the experienced, to purchase a going concern is surely looking for trouble.

The purchaser with knowledge of his subject goes into the business with his eyes open and can blame no one but himself. It is safe to say that 95 per cent. of those at present taking up poultry farming do not know their subject. Hence this article.

Having been given advice as to water possibilities, roads, markets, etc., we have now settled on a location which, for the sake of discussion, is fenced. Our first work is to draw out a plan of the block, showing north and south points in relation to boundaries. Mark the road, then select the place for the residence.

The nearest settler will give an idea about water, quality and depth. Try and locate the pumping plant on as high a level as possible. This assists the layout with gravitation.

Having settled on residence and water supply, place a fowl shed in position. This is a trouble maker. Your neighbour, no matter how little you consider he knows about poultry farming, can tell you from which direction the weather comes.

Sheds.

We have always been told that it is necessary to have the sun's rays in the furthestmost parts of the fowl house, which means that the sheds should face east (in Western Australia), but some of the worst rains come into the front of a shed facing east. Rain in a shed means mouldy litter, and mouldy litter means trouble. One cannot face them north or south because of weather, so plan for a shed whose frontage is south-east. It receives very little storm rains in the front. It certainly gets wind, but wind is not such a bad thing. If the shed is intensive or semi-intensive they have depth and the wind is broken up before it reaches the hens. Most of the east winds will drive hard against the end of the shed. Anyway, we cannot have it good all the time, and wind is less trouble than rain. It is not necessary to have the sun's rays into the back of a modern well-ventilated cosy clean shed.

It will be understood that allowances must be made for different districts, but the same arrangements apply—always place the front of the shed in a position which lets least rain into it. Place the shed back and ends against the weather and not too close to the residence.

The extensive method of poultry farming includes all systems of raising stock which allow of free range for the birds. The intensive method includes all systems whereby the stock are confined to a limited space. Intensive poultry farming requires considerable skill in the management of the stock and it is not considered advisable for a beginner to embark on that system. Semi-intensive is a modified system whereby the birds have commodious housing but are allowed sufficient ground for exercise. It is the most popular form in Western Australia.

The semi-intensive shed is constructed in sections holding about 150 birds each, two sections being a self contained unit divided in the centre by a dry mash hopper. It should be 64 feet long by 16 feet deep, inside measurement, divided into two sections 32 feet wide, the roof 6ft. 6in. high back and 8ft. 6in. high front. This shed contains perches, nests, water supply and dry feed hoppers. A full shed would be four sections 32ft. x 16ft., making 128ft. long over all with yards in front 75ft. long. All sections are connected by doors inside at the front and have doors at back, and into each yard at one end of each section; the front door to be also the connecting gate to each yard. (A plan will be forwarded upon application.) The above shed will hold 600 birds divided into flocks of 150, and the only distance to walk in feeding is 128 feet there and back—a saving in "leg" power, time, and length of piping to have automatic water supplies to each section.

The perches at the back are hinged into the back wall so that all the perches can be lifted out of the way at one action. The nests are inside and 3ft. off the ground, eliminating backache in collecting eggs. The water is 3ft. high so that no sick fowl can contaminate the water supply. Place litter all over the floor except under the perches (board round these). This litter is the dining room, and it also keeps the eggs clean.

We place two of these long sheds on the plan, one in front of the other with 16 feet between the end of the yards and the back of the second shed.

Breeding Sheds.

Make provision for breeding sheds 8ft. x 5ft. with a small yard 16ft. x 32ft. conveniently situated and place the feed shed centrally situated between residence, laying sheds and breeding pens.

The egg packing room should be near the feed shed but not part of it, and the incubator room should be near the residence—you will find it convenient on a wet night when some trouble requires attention.

The plan is complete except for the green feed plot. This should be near the source of the water supply. It is here we need big pipes, and the cost of big pipes is heavy so do not have the plot too far away. The piping to the residence and laying sheds is of smaller diameter in comparison to that to the irrigation.

ERECTION.

Having laid out the farm on a piece of paper, decide on the method of erection.

If you have a sandy location I favour building with cement bricks. These are easily made and laid by a novice and cheap compared to wood and iron, look dignified when erected, and are very easy to keep free from pests. To those who wish to build in wood and iron or asbestos sheets the procedure is the same.

After the water supply is assured and the home (whether temporary or permanent) erected, start and erect one half of the long 128ft. shed, i.e., 64 feet. This,

when completed, will house 300 birds after using it as a brooder shed. Leave the centre in such a state that it can be extended to 128 feet when you have the time.

Lucerne.

Dig up the lucerne plot, clean it well, lime heavily, and after three weeks dig in manure. Plant in rows two feet apart to allow of cultivation between rows. A good length of row is 80 feet. As lucerne when fed to fowls must be succulent, it needs top water and an irrigation system.

Irrigation.

When considering the irrigation plant, it is well to look ahead. Consult an irrigation specialist about water and how to obtain it. Different localities require different methods, but for this article we can assume that water is of sufficient quantity at easy depths to pump to the top of a tank standing on a stand 20 feet from the ground. Such a height will give sufficient pressure for a goodly number of sprinklers to be operated together.

From the source of supply run a 2in. pipe down the middle of the plot, which is 160ft. wide. At every 16 feet place a 2in. x 1in. cross for side branches 1in. diameter. Each branch contains five sprinklers on $\frac{3}{4}$ stands 3ft. high and are located 16 feet apart, the first sprinkler being 10 feet from the main. Each row has a 1in. stop cock to serve so that it can be used independently—use $\frac{3}{4}$ single butterfly sprinklers. The lucerne being planted in rows two feet apart allow of the sprinkler being midway between rows. Obtain advice for lucerne growing and follow it.

Water.

Have two outlets from the service tank, one feeding the lucerne plots, the other to the residence and fowlshefts. The outlet for the irrigation should be 18in. to 24in. higher inside the tank than the outlet for the residence so that if one forgets to turn off the water when irrigating, there is a reserve of 18in. to 24in. left in the tank.

Run the water right down to the fowl shed and inside to a trough fed by a ballcock. These ballcocks only cost from 6s. upwards and are a time saver.

When laying your pipe line look well ahead and put into position fittings necessary for future requirements. It is surprising how many you will desire and what a lot of future trouble will be saved.

Stocking.

We have now reached the time when we can consider stocking the farm. It will be essential to consider the requirements in brooders.

There are two popular systems—cold brooding and hot brooding. The writer favours the system of artificial heat, not because he condemns cold brooding but because it has been found the easiest and secures good results.

Should it be desired to "cold brooder" the chicks, purchase a reliable make. Makeshifts sometimes are successful but we are out to succeed by orthodox means.

Many and varied are the designs of hot air and hot water systems. All are efficient when used intelligently and all can be disastrous if neglected. Nevertheless, again obtain advice from a successful rearer of chicks and follow his practice until you understand his methods; you can then apply your own ideas with profit.

When stocking there are several procedures which can be adopted—(1) buying two year old hens just starting to moult; (2) day old chicks; (3) pullets 12 weeks old; and (4) purchasing fertile eggs and hatching them yourself. Do not consider No. 4, because our knowledge of poultry farming has not progressed that far in experience.

(1) What happens if two-year-old hens are bought? We must understand that these hens are just beginning a moult and will be in a moult for three to four months. They can be obtained cheaply but to the purchase price must be added the cost of feeding and the culling out of the indifferent hen. Those hens have passed their most profitable period else they would not be sold; they must be purchased direct from their breeder or you may have a dealer "telling you a story" and when you do get them they are only good for another year.

Since they are bought in February and March, they start to lay in June to August, right at the time you should be breeding chickens to take their place next year. Unless you are prepared to augment them with younger stock in the spring, I would advise you to leave two-year-old hens alone.

(2) Day-old chick purchases. This seems to be the most popular way of starting, but trouble might be bought also. Place the order and a deposit thereon with a reliable breeder in order to obtain the supplies when they are desired. Heavy breeds in July and August, light breeds in August and September. Brooder equipment must be ready and heated up for their reception. One runs the risk of deaths from lack of knowledge of feeding, etc.

(3) 12 weeks old pullets are about the best means of starting. No brooding equipment is required. All troublesome cockerels are non-existent, and the dangerous stage of rearing has passed, and last, but the most important, is that one obtains 100 pullets selected and culled right up to that age, at a price which is astoundingly cheap at about 3s. to 3s. 6d. per head. Place those pullets right into the sheds and most likely they have already been taught to perch.

The only work is to feed those pullets to maturity on a plain body-building ration. As this stage is so simple, I must revert to the purchase of day-old chicks as a starter. All cannot get 12-week pullets and chicks seem to be the most popular means of starting.

Having placed the order, purchased the brooders, plant and feed, we will now trace the period of growth up to laying stage, bringing into the picture the 12-week pullets when the day-olds have attained that age.

Chickens.

When the chicks arrive one can generally estimate they are ready for their first meal, which should consist of flaked oats and bran on a piece of brown paper until they start to pick up. Do not give water right up on their coming from the travelling crates. Wait until they have had some little food. Meatmeal in a ration for day-old chicks is a controversial subject. Sometimes I feel like advocating its omission, at others I must have it included. Until three weeks old the chick can thrive with or without it. To give it does not do any harm providing it is *carefully* regulated; but to overdo it is tragic. As we are building up our farm and studying at the same time, I am advocating its use from the start as we can carefully watch the results.

Feed the following rations:—Dry mash of equal parts wheatmeal and bran with a 5% of bulk meatmeal and 2½% of bonemeal—plenty of feeding room and you can with safety leave it before them all day long. Plenty of sand and litter on the floor of the brooder room keeps them amused and keeps down vices. At about 4 p.m. take away the mash and give cracked grain as an evening meal. Fine shell grit and charcoal should be in front of them always. After a week give them all the green feed (cut fine) that they can consume. Let in plenty of daylight and keep the shed as open as possible. The chicks must have fresh air—plenty of it—and unchecked daylight. Glass windows are no good. If the brooders are efficient no trouble should occur with an open shed. It should be the main idea to harden the chickens as soon as possible, but do not overdo it by allowing the chicks to get away

from the warmth until they know where it is to be found (about three days in an enclosure is sufficient), then let them travel as far as they desire. Keep them growing and start culling from the first hour.

Get away from that old style of grading the chicks according to size. Any who do not keep up to the average in growth should be killed. They make excellent "mock pigeon" pie after four weeks old. One must see "growth" in every action taken.

Do not cast slanderous terms on the little chick which goes to bed showing a crop like a large marble, rather encourage it. You are learning the first lesson on feeding, i.e., "put into the birds what *you* want, not what they want."

Keep a good lookout for chills, the most prevalent and dangerous ailment to baby chicks. It is mostly caused through overcrowding; that is why only 75 per cent. brooder space is advocated. If the temperature is right the chicks spread out and do not crowd when under the brooder. Keep reducing the heat as they get older. At about 8 weeks you can give them in the morning a plain wet mash of 8 parts green, 5 bran, 3 parts wheatmeal, $\frac{1}{2}$ meatmeal, and $\frac{1}{4}$ bonemeal. Keep the dry mash before them all day, and whole grain at night (fed in the litter on the floor shed), keep culling and keep making growth.

They pass to 12 weeks old and all the cockerels are in pens by themselves. Unless these cockerels are of special strain, feed for flesh and market as soon as possible. (Exit cockerels.)

At about 16 weeks old the pullets are doing fine, all are feathered and quite plump. Keep them growing—let them have all the open space they can. Cut down the meat meal and add a little more bran. Personal observation added to all the knowledge you should have learned by continuous reading, will tell you how things are going along. Plenty of green feed should be given after grain at night also. Keep going round the sheds at night handling the birds. They get to know you, like it and so you progress to that most interesting stage when the combs start to grow apace. You now get the nests ready.

Nests.

Nests should be inside the shed so that we keep the eggs clean, and collect under cover. Three feet from the ground and no backaches. Put in trap nests. Although not essential, trap nests are the only accurate means of telling what each pullet does and how she does it. Cull a pullet which lays a misshapen egg. One that lays a blood spot in the egg is easily detected and trap nests do not cost much money. They can be made for one shilling each and are self-acting. Each pullet, on laying, is banded with a celluloid band embossed with a number, a red band this year, white next year, blue following. You can always tell the age without trouble.

Keep them growing. The continuous study and handling informs you whether a bird is putting on growth. If she is not, market her for she will be unprofitable, and do not put the pullets on to a layer's ration just because they start to lay.

Feeding a Pullet for Eggs and Growth.

A pullet is born into the world with the one object of reproducing her species. That object being a most exacting practice needs stamina and vitality in order to attain its achievement.

One should aim for eggs and body. Do not try for eggs only and thereby cause a breakdown. There is quite enough trouble without helping it along. Keep that pullet on a grower's ration:—8 green, 5 bran, 3 wheatmeal, $\frac{1}{2}$ meatmeal, $\frac{1}{4}$ bonemeal, 1 oilcake (damp measure). Dry mash all day and wheat at night followed by green feed. A large quantity of eggs will be obtained on the above ration;

but best of all, growth is obtained along with eggs. A laying ration is a forcing ration, and although you will get 10 more eggs per year the constitution of the pullet is broken down and she is of little use as a reproducer of her species. Keep her growing.

It will be noticed that I am an advocate of a dry mash hopper in front of the stock all day. Many will say that the birds get fat. Any who say that have forgotten my statement—"Put into the birds what you want, not what they want." If an egg-forming ration is in that hopper those birds cannot receive a fattening ration. But there is also another reason to explain which you must recall that statement found in every book on elementary poultry—"The average ration for a bird is 4 oz. per day of dry matter." In discussing this we must take several matters together—egg laying, wet mash, green feed and trap nesting—to explain our point.

When analysing that statement of 4 oz., it must be understood that it also means an average producer and, as the average production is around 130 eggs, and as "*you put into the bird what you want, etc.*" how can a producer of 230 eggs lay that number if you only give her an average ration?

A 4-gallon kerosene tin will hold about 50 to 60 ration of wet mash for your stock. One can assume that the birds are intelligent enough to know that they can get no more until the grain feed in the afternoon and so they eat all they can, both the small producer and the high producer. The small producer cannot use all the egg-forming ration to advantage so it is lost. The large producer does not get enough. Now place in front of the same birds a dry mash hopper and study the trap nests. It will be found first of all that the kerosene tin will feed 100 rations in the morning and all will be content. When registering the trap nests and watching the birds when released you find the solution to feeding the high producer.

When released from the trap nest, the high producer rushes (no other word for it) to the hopper, while the low producer casually goes outside the shed, finds a convenient hole and settles down, which proves that the high producer must get more feed than the low producer, and that a kerosene tin to 100 is sufficient feed for a low producer.

When feeding at night all will leave the hopper to partake of the grain.

Four ozs. of dry matter also means 2 ozs. of a mixture of bran, pollard or of wheatmeal, meatmeal, oilcakes, bonemeal at morning and 2 ozs. of wheat at evening.

Measure out 2 ozs. of mash mixture and place it in a well developed crop and see how little space is occupied. The crop is about half full and anything half full is hungry, and as a hungry bird is not contented fill it up with a bulk (greenfeed) which, besides filling the crop, aids digestion.

Weigh out 2 ozs. of wheat and the same thing occurs—the bird would go to bed hungry—therefore fill the crop with greenfeed fed after the wheat. Beside filling the crop it again aids digestion. Do not feed more than 2 ozs. wheat with that 2 ozs. mash.

The feeding must be studied in a careful manner. We may certainly give the birds "as much mash as they will clean up in 20 minutes" and we hand out the wheat as if it does not cost anything.

We know what is meant by a balanced ration (1 part protein to 4.5-5 parts carbohydrates). The mash is mostly the protein portion and the wheat the carbohydrates.

Let me explain how lack of study in feeding causes disastrous results. It is common in the industry for the attendant to be tired just when the evening meal is due. He knows his own tea is ready for him and so the fowls are given their wheat by throwing down the predetermined quantity and the attendant retires to his own meal. This is quite satisfactory for a while, when suddenly the birds will not eat

their morning mash. The surplus is collected and fed to cockerels and ducks, etc. That evening the fowls are again thrown their evening grain ration and left. Again the next morning less mash is eaten until it is most marked that the birds are going off the lay. The farmer consults his next door neighbour, accepts all sorts of advice and finally giving up in despair goes to a successful farmer or an adviser with his troubles. He is then told that his birds are overfat or starved and an analysis of his actions brings home to him that he has carefully studied rule of thumb methods and has not applied common sense.

Let us analyse the proper procedure. Birds, like men, are inconsistent eaters. At times they feel indifferent to feed and we have thrown to them their pre-determined ration of wheat. The birds this evening leave half the wheat, but in the morning before the attendant is awake, the birds are down from the perch and consume the remainder, making their crop half full before mash time. The same thing repeats itself daily until disaster follows. The birds are getting little mash (protein) and more than sufficient wheat (carbohydrates and fats). Their ration becomes unbalanced, and when unbalanced in such a way the birds are not receiving sufficient protein but more than is necessary of carbohydrates and fats. Hence they get fat and go off the lay.

The intelligent man feeds his wheat earlier and watches the approach of the birds. If they are ravenous he gives them 90 per cent. of their ration. If they are sluggish to the approach he only gives them 10 per cent., so that in the morning they are ready for the mash, but he does not give them the full ration of mash. Only 75 per cent. of it in order that the stock desire more wheat that evening. Balance the quantities of wheat and mash that the proportions of protein to carbohydrates and fats are as near as possible balanced as 1 of protein to 4.5 or 5 of carbohydrates.

At the same time see that their crops are full at evening meal by feeding as much green feed as the crop will hold after they have partaken of their desires in wheat, but never feed more than 2 ozs. of wheat at night.

It is very easy to see if the stock are feeding correctly. How many forget to balance the quantity of feed consumed over a period with the number of birds fed. For example, 450 average birds consuming 4 ozs. per day of wheat, bran, pollard, meatmeal, etc., should consume 1 cwt. of feed per day or 7 cwt. per week apart from greenfeed. Quite easy to work out, but it does give an idea of how the birds are eating.

It must be understood that when **culling heavily under trap nests** the consumption is higher because the birds are then above the average.

In this discussion we have considered all things with mathematical precision. We must, of course, while keeping balances in mind, use initiative in application. Experience by keen observation, makes the figures look false, but they are the best that can be done in order to explain the procedure. Condition of the flock, egg production, and the last but not most important factor, colour of faeces or droppings, must be studied closely. The colour is the best guide as to a balanced ration, no matter how mathematically correct the figures may be. It is here that the successful poultry farmer discovers his faults in feeding, and it is from here that he adjusts his ration, and adjust it he must, almost weekly, no matter how close he has worked to figures.

The colour of the faeces should be "black-brown" tinged with a white smear. If it gets lighter in shade to a mustard colour the birds are receiving too much fat-forming material and not enough protein. We are not discussing the colour which denotes sickness in its common application, but only feeding defects.

The birds are about to start laying at this period. In the December issue the feeding of laying stock and its subsequent results on the birds' condition will be studied.

MALTING BARLEY.

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During recent months a certain amount of attention has been devoted to the possibilities of increasing the quantities of malting barley grown in this State. As will be seen from Tables 1 and 2, the amount of malting barley of satisfactory quality grown in past years has been insufficient to meet local requirements.

TABLE 1.—IMPORTS OF BARLEY INTO WESTERN AUSTRALIA.

Season ending 30th June, 1934.

1928-29.	1929-30.	1930-31.	1931-32.	1932-33.
centals.	centals.	centals.	centals.	centals.
2,610	267	77	30	28,450

TABLE 2.—IMPORTS OF MALT INTO WESTERN AUSTRALIA.

1928-29	1929-30.	1930-31.	1931-32.	1932-33.
centals.	centals.	centals.	centals.	centals.
15,566	37,615	16,610	14,505	26,415

This shortage is largely the result of the policy of the local maltsters, who aim to maintain a small deficiency so that all the local barley of satisfactory quality may be absorbed by the home market. The maltsters estimate their requirements a year ahead, then supply seed to growers and make arrangements with them concerning the disposal of the subsequent crop if it proves to be of satisfactory malting quality.

In 1932-33 the Council of Industries (which has since ceased to exist) undertook publicity work in connection with the stimulation of malting barley growing. The objects were to demonstrate that really good quality malting barley could be grown in Western Australia, and to increase the available supplies in order to meet an anticipated increase in the local demand, and also, if possible, to build up a small export trade. A series of trials was initiated and carried out in 1933. Briefly, the arrangement was that the Council made available to a certain number of farmers throughout the State a small quantity of good quality seed of the variety "Pryor," that being the most commonly grown variety for malting purposes. The farmer planted this and furnished details of manuring, cultivation, etc., to the Council. If the barley was of satisfactory malting quality the farmer was then able to sell to the Council at a price previously fixed; last year this was 3s. to 3s. 2d. per bushel f.o.r., Perth. The Council in turn disposed of the barley to the maltsters.

The results of these trials, although in some respects inconclusive, showed that malting barley of a quality quite the equal of the best South Australian barleys could be grown in a number of districts in Western Australia, but that it was essential that care should be exercised in the choice of district, soil, cultural methods and harvesting, and that "hasten slowly" was an excellent motto for farmers to adopt when considering the growing of this crop.

In view of the possibility of some farmers turning to barley growing as likely to be a less unprofitable line of production than wheat, this article has been written in order to give a brief account of the position of barley in world trade, and also some account of its present position in Western Australia.

Barley is the hardiest of the cereal crops and has been cultivated since ancient times. It was then a staple article of human diet but now its uses are confined

to its value as a food for livestock and its use in the malting and distilling industry.

It thrives best in regions of moderate temperature and not excessive rainfall. It is a shallow feeder and gives best results in rich, porous, well-drained soil.

It is grown almost solely for its grain, the straw, although suitable for feeding to stock, having little saleable value. The better grown samples are greatly in demand for conversion into brewing malts and, in consequence, command a higher level of prices than ordinary feed barleys. No cereal is more carefully grown and harvested than the best barleys, and considerable judgment is exercised by buyers of malting barleys.

Feed barleys enter into direct price competition with wheat, oats, maize, and other common stock feeds.

Prior to the War, world production of barley amounted to about one-third the production of wheat, Russia being by far the largest producer.

Since the War, world trade in barley has been decreasing in volume, due to a definite decrease in consumption in the chief importing countries, notably the United Kingdom and Germany; from five million tons in the period 1909-1913 it has declined to three and three-quarter million tons in 1926-1930. This has led to some accumulation of surplus stocks despite the fact that there has been a reduction of acreage in exporting countries as compared with pre-war years. Just at present, however, due to drought in overseas countries, the demand for barley is increasing and prices are rising.

The chief exporting countries are now Roumania, Argentina, and Russia in that order, and the chief importing countries the United Kingdom and the Netherlands, followed by France and Germany.

The two main types of barley are two-row barleys and six-row barleys. Grain of the latter type can be distinguished by its rather bent or twisted kernels, as compared with the straight and more plump grains of the two-row varieties. The best known local examples of these two classes are the varieties "Pryor" and "Cape."

With the exception of the best types of Californian barley, six-row barleys are but little used in the brewing trade outside North America, though in the latter region they have always been preferred to the exclusion of the two-row type. The reason for this difference in preference is rather difficult to arrive at. Australian brewing practice, though built up on English lines, now follows continental ideas, and only two-row barleys are used.

The buying of malting barley is done by men who, as a rule, have had years of experience in the business. In England home-grown barley, and the better portion of the Californian crop, are sold on sample; the remainder of the Californian crop is sold as "standard" or "superior to standard," while all other malting barleys are sold on monthly F.A.Q. samples obtained under the supervision of the London Corn Trade Association.

Barley used for distilling—as distinct from malting—can be described as carefully selected feeding barley of high germination, though a good feed barley is not necessarily suitable for distilling. The quality is lower than that required for malting purposes and a high nitrogen content is necessary in a distilling barley.

The maltster has very definite ideas as to the characteristics of a good malting barley and these requirements must be kept clearly in mind by the grower.

As the malting process consists of allowing the barley grain to germinate under suitable conditions, then arresting the growth after a short period, during which certain chemical changes have occurred within the grain, it is obvious that high germinating capacity is essential. Anything which tends to retard or reduce germinating capacity correspondingly reduces the value of the barley. Uniformity

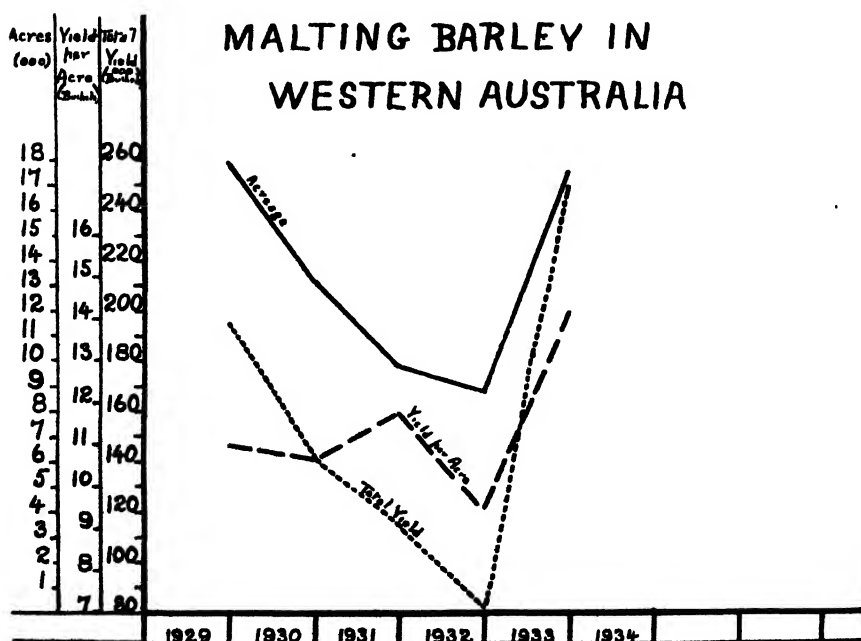
and evenness of germination are also essential. Such factors as uneven size of grain, broken kernels or damage to the skin or husk must all be taken into account when assessing the malting value of a sample.

The grain itself should be plump, even, thin-skinned and have a bright appearance. A sample containing an appreciable quantity of small, pinched grain is unsuitable for malting purposes.

The barley must be reasonably free from smut, weed seeds, chaff, foreign grains and other impurities.

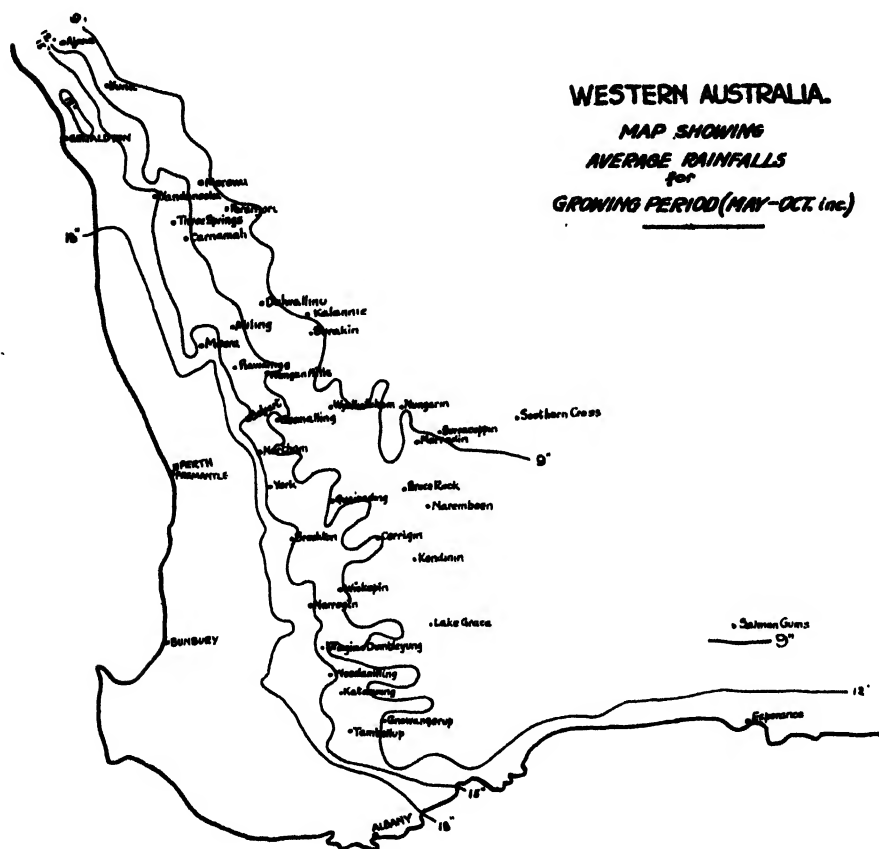
The most important single factor in determining the malting quality of a sample is the nitrogen content of the grain. A high nitrogen content is not desired; up to 1.5-1.6 per cent. is not objected to, but anything above that is regarded as high and the value of the barley for malting purposes is reduced accordingly. Fortunately for buyers the nitrogen content of the grain is fairly closely correlated with appearance, particularly with the internal appearance of the grain. If, on cutting with a sharp knife or razor blade, the grain proves to be white and mealy, it usually follows that the nitrogen content will be satisfactorily low and the carbohydrate content correspondingly high. If, on the other hand, the grain has the flinty, transparent appearance of a good quality wheat, it is safe to assume that the nitrogen content will be high and the grain will have a correspondingly reduced value for malting purposes.

The statistics relating to acreage, yield per acre and total yield of malting barley in Western Australia are given in Figure 1.



The acreage and total yield declined steadily from 1929-30 to 1932-33. In 1933-34 the acreage rose suddenly, and, as the yield per acre was considerably above that for any of the previous four years, the total production was comparatively high. The reason for the increased acreage in 1933-34 has already been explained.

The best quality malting barley is received from the districts of Toodyay, Moora, Victoria Plains and Dumbleyung, and it is from these centres that most of the local supplies are drawn. The average rainfall for the conventional growing period (May to October) is between 12 inches and 16 inches (Fig. 2). The soils are mainly those of the brown earth type (1).



Environment is the major factor which influences the malting quality of a barley sample. Generally speaking a district which produces good quality wheats will not produce a good sample of malting barley. A relatively hot dry ripening period favours the accumulation of nitrogen in the grain and this leads to high quality in wheat, but, from the maltster's point of view, poor quality in barley. For this reason the heavier forest country of the Eastern wheatbelt is definitely unsuitable for the production of the latter crop. Fair quality crops are sometimes grown on the lighter types of soil in districts with a growing period rainfall under 12 inches, but it is found that the best results are obtained from light to medium textured soils in districts with a growing period rainfall of from 12 inches to 15 inches. The heavier more fertile soils will give the biggest yields, but the risk of producing a poor malting sample is much greater than on the lighter sandier soils.

¹ Prescott: The Soils of Australia in Relation to Vegetation and Climate.

The effect of environment on quality is well illustrated by the results of trials last year at the Wongan Hills Light Lands Farm and the Merredin Experiment Farm. "Cape," "Pryor," some Californian six-row barleys and several types of the best English malting barleys were grown at both farms.

At Wongan Hills the soil is of the lateritic sandplain type characteristic of large areas of the wheat belt. It is deficient in plant food, particularly nitrogen and phosphates. The barley was sown during May on fallowed ground and superphosphate (22 per cent. P_2O_5) applied at the rate of 120 lbs. per acre. The rainfall during the growing period last year was 12.6 inches.

At Merredin the soil is a brown clay loam, with a calcareous sub-soil, typical of the heavier forest soils of the Eastern Wheat Belt. With the exception of phosphates it is relatively well supplied with plant food. Studies have here shown that, during a period of summer fallow, there is a building up of available nitrates in the soil.† This is important from the point of view of barley quality. The barley was planted during May on fallowed ground together with 112 lbs. of superphosphate per acre. The rainfall for the growing period was 7.84 inches.

Owing to the late opening of the season, no germination took place at either farm until the end of May.

Germination percentages and analyses for moisture and nitrogen and 1,000 grain weight of the samples taken at each farm are given in the following table:—

TABLE 3.—ANALYSIS OF BARLEY SAMPLES GROWN AT MERREDIN AND WONGAN HILLS.

	Identification No.	Percentage Germination.	1,000 grain weight (grammes).	Moisture.	Nitrogen.
<i>Sample from Merredin Experiment Farm.</i>					
1. Californian Brewing H. 42 ...	M1	95	34.2	10.3	2.3
2. Best Californian Brewing ...	M2	99	36.4	10.3	2.1
3. Cape	M3	*96	36.4	10.7	2.3
4. Plumage Archer Chevalier type	M4	96	38.8	10.3	3.0
5. Plumage Archer (1924) ...	M5	99	40.4	11.1	2.9
6. Plumage Archer No. 2 ...	M6	98	39.8	10.3	3.0
7. Plumage Archer, Type HCL 477	M7	98	39.8	10.1	3.1
8. Pryor	M8	100	41.8	10.2	2.1
<i>Samples from Wongan Hills Light Lands Farm.</i>					
1. Californian Brewing H. 42 ...	W1	93	47.0	10.3	1.6
2. Best Californian Brewing ...	W2	99	48.8	11.1	1.5
3. Cape	W3	*68	49.8	9.8	1.4
4. Plumage Archer Chevalier type	W4	99	43.0	10.3	1.9
5. Plumage Archer (1924) ...	W5	99	43.8	10.3	1.6
6. Plumage Archer No. 2 ...	W6	100	42.2	10.4	1.5
7. Plumage Archer, Type HCL 477	W7	100	39.4	9.9	1.5
8. Pryor	W8	*88	45.4	10.4	1.3

* Somewhat mouldy and slow rate of germination—grain probably rather immature when harvested.

The most striking difference between the samples from the two districts is in nitrogen content. In some cases it is twice as high for the same variety at Merredin as at Wongan Hills. This was reflected in the appearance of the samples, those from Merredin being rather small and pinched, and appearing

† Teakle and Burvill: Fallowing for Fertility; W.A. Journal of Agriculture, Vol. 7, p. 119.

hard and flinty when cut. Those from Wongan Hills were paler in colour, plumper, had a starchy appearance when cut and gave the impression of being of fairly good malting quality.

The samples were forwarded to the London firm of Messrs. W. Watson & Co., from whom most of the seed was originally obtained through the courtesy of Mr. K. Edwards, of the York Roller Flour Mills. The agents submitted them to several malsters, who expressed the opinion that, while the Merredin samples were definitely unsuitable on account of their steely character, grain similar to that grown at Wongan Hills would practically all be suitable for malting purposes. Of these it was considered that the Californian six-row types would be the most saleable.

This latter remark is of considerable interest as the prospects of exporting the two-row types at a profitable price do not appear bright. Speaking of Australian production, when discussing the possibilities of Empire countries supplying a larger proportion of English requirements, Professor Clark* says: "No doubt more barley could be produced and the quality of export shipments of malting barley be improved by better seed and better harvesting methods. It is doubtful, however, if the existing demand for malting barley of this kind in the United Kingdom would remunerate the Australian producer for the extra cost and effort involved in attempting to gain a greater share in a market already supplied."

There does appear to be some prospect, however, of a market being found in England for the best samples of the six-row "Cape" type at a more remunerative price owing to its higher yielding capacity under local conditions as compared with "Pryor." For a long period Californian sun-ripened six-row barleys have enjoyed a favoured position with the English maltster. A certain percentage of such barley is necessary for the production of the light sparkling bottled beer at present in demand, and, so far, California has been the sole source of supply. There is now a tariff preference in England for Empire-grown barleys and, in addition, the Californian product will now have a wider home market to enjoy and, consequently, there will be less available for export at the old level of prices. As, climatically, we should be well situated to produce a barley similar to the Californian article, it is likely that a market could be found in England for some of our six-row "Cape" barley, provided that the requirements of the maltster are met as regards plumpness, uniformity, low nitrogen content, and freedom from harvest damage.

As previously mentioned, the English agents to whom the samples were sent are emphatic that there is a much better prospect for marketing a barley of this type in England than attempting to push the export of the two-row varieties in a market which, up to the present, has been over-supplied with high quality grain of the two-row type.

The cultural requirements for barley are very similar to those for wheat. Seed should be sown at the rate of about 45 lbs. per acre. Well drained soil should be chosen as barley will not stand wet feet. In the recognised wheat districts the grain should be planted late in April, or early in May, and superphosphate applied at a rate similar to that for wheat. It is advisable to pickle the seed as a preventive to loose and covered smut.†

It is necessary to take the utmost care when harvesting to ensure that the grain suffers the minimum amount of damage in the process of threshing. No matter how good the quality of the grain it will be rendered useless to the maltster if it has been skinned and cracked when harvested.

* Grant: Barley Survey; E.M.B. publication. No. 62.

† Barley Smuts and their Control, Leaflet No. 375, W.A. Dept. of Agriculture.

Partial skinning makes for uneven germination and it is better that some of the awn should be left on the grain rather than have the threshing so severe that it damages the skin.

If the grain is not to be unduly damaged, it is necessary to give more space between the beaters and concave than is usually the case for wheat, and, if necessary, reduce the pace of the machinery. It is essential that the grain should not be allowed to repeat through the peg drum. However, the actual adjustments necessary to the different types of harvesting machinery can only be determined at the time by the farmer himself after observing the character of the work being done.

In conclusion, it must be emphasised that farmers who are considering growing malting barley should proceed with caution. It is first necessary to decide whether the district and soil is suitable for the production of the crop, then to consult the local maltster to ascertain the prospects for the future disposal of the grain, if it is of suitable malting quality. Close attention must be given to time of planting, seed treatment for disease, and particularly to harvesting. It should also be realised that high yields and first-class quality seldom go together and that, particularly in dry seasons, the best quality grain will be obtained from the lighter soils. Despite all precautions, however, seasonal influences may result in an inferior malting sample, and for this reason it is wise to look upon the growing of malting barley as a side-line, rather than to have it as the main crop.

The prices paid by the local maltsters for malting barley for the past five years are shown in the following table:—

TABLE 4.—BARLEY PRICES (F.O.R. PERTH) PAID BY THE MALTSTER FOR THE PERIOD 1929-1933.

	1929-30.	1930-31.	1931-32.	1932-33.	1933-34.
Price per bushel—	s. d.	s. d.	s. d.	s. d.	s. d.
Top	4 3	3 0	3 0	3 3	3 3
Average	3 11½	2 11	2 11	3 2	3 2

For export purposes "Cape" or "Californian" six-row barley should be more remunerative than "Pryor" on account of superior yielding capacity. If a farmer has a plump, mealy, well-harvested sample of one of these varieties there should be little difficulty in his arranging for the export of a trial parcel to England.

The writer wishes to acknowledge his indebtedness to Mr. L. Barrett, of Union Maltings Ltd., for much helpful criticism and advice, and also to Mr. K. Edwards, of the York Roller Flour Milling Coy., who made available samples of different varieties and later forwarded these to England for report by Messrs. W. Watson & Coy.

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THE DETERMINATION OF AGE IN THE HORSE.

By A. SHILKIN, B.V.Sc., Department of Agriculture.

For all practical purposes the indications as to the age of a horse are furnished mainly by its teeth and more particularly the lower row of front or incisor teeth.

As in humans, the horse has two dentitions, namely, first a temporary dentition in which the milk or foal teeth are present and secondly the permanent dentition, which replaces the former.

The milk incisors or nippers differ from the permanent ones by being shorter and whiter, having their outer surface smooth, while that of the other generally has a slight vertical groove; and from the fact that the milk incisors gradually become shorter and shorter as soon as they come into wear; the opposite being the case with the permanent ones.

A short resumé of the numbers and types of teeth in the adult will no doubt be advantageous before giving an account of the eruption ages.

The incisors are the nipping or biting teeth, situated at the entrance of the mouth. These are six in number for each jaw. The two front incisors are termed *centrals*; the next *laterals*; and the two farthest back the *corners*.

The molars form four ranks, two for the lower and two for the upper jaw. These are grinding teeth and in the mature animal there are six in each rank and they are separated from the incisors by a space known as the interdental space. In this space, the canine teeth, tusches or tusks are found in males only.

In determining the age of a horse the molar teeth are usually disregarded and reliance placed mainly on the incisors. The eruption ages of these, which are necessarily approximate, are as follows:—

At *birth* the two central incisors are present.

At *9 weeks* the two lateral incisors are present.

At *9 months* the two corner incisors are present.

The first and second temporary molars are present at birth or soon after and the third appears at about three months. At *2 years* the horse has a well developed full temporary mouth and may be mistaken for a five-year-old. The teeth usually come into wear three to four months after eruption, depending on the type of feed, country, etc.

At *two and a half years* the central milk incisors are shed and replaced by permanent teeth.

At *three and a half years* the lateral milk incisors are replaced by the permanent teeth and

At *four and a half years* the permanent corner incisors appear.

In the males, the canine teeth, which are permanent, appear at between four and five years.

Up to 5 years the age can be told with a considerable degree of accuracy. After this, guidance as to age up to 8 years is obtained from the disappearance of the infundibulum cup or black mark on the tables of the lower incisor teeth.

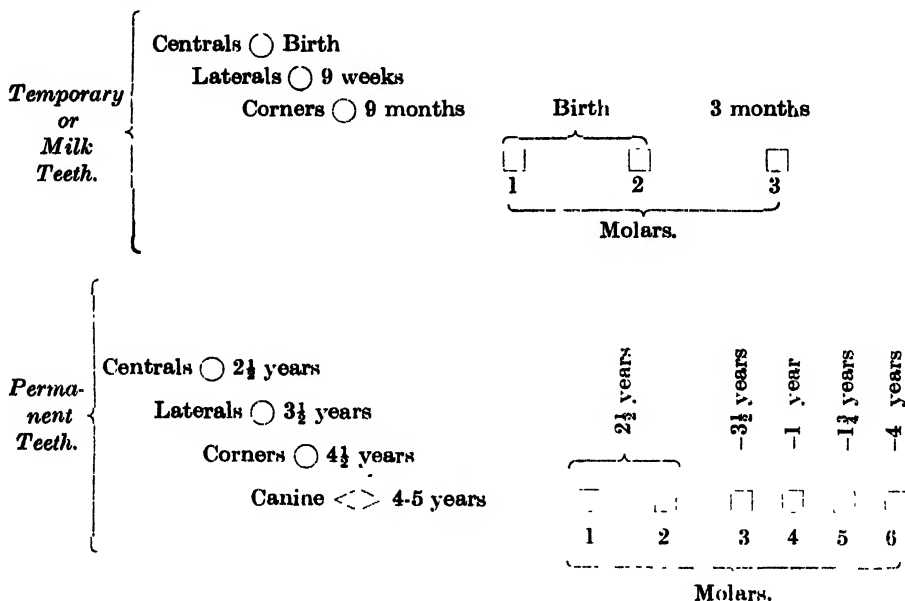
At *6 years* the infundibulum disappears from the lower centrals.

At *7 years* the infundibulum disappears from the lower laterals.

At 8 years the infundibulum disappears from the lower corners.

After 8 years the ageing is purely a matter of experience and judgment. As the horse ages the teeth become longer and nearer the horizontal, the oval table surface gradually becomes triangular and smaller and the gums recede. The black mark in old teeth is really the pulp cavity coming upwards and is distinguished from the infundibulum or cup previously mentioned by the fact that it has no enamel round it.

The eruption ages of the teeth can thus be represented diagrammatically and a constant mental picture of this is a helpful factor in determination of ages. The eruption ages of the molar teeth are included here for completeness.



The above represents one side of the lower jaw.

In Australia horses are aged from the 1st August so that in ageing a young horse, the actual date of whose birth is unknown, in case of doubt, he should be assigned the younger of the two ages if his "class" birthday be near at hand, the older of the two if it be recently passed. Thus suppose a horse had a "full mouth" (all his teeth permanent) in June, but his corner incisors showed little or no wear, he should then be aged as a 4 year old and 2 months later would become a 5 year old. At the worst we could here be only a couple of months out, but if he was aged as 5 years, at least 9 or 10 months would be added to his age.

The term "rising" is, as a rule, applied to a horse's age when it is less than that which is stated and "off" when it is more. Thus a horse "rising five" is a 4 year old which is nearer 5 than 4. An animal "4 off" is a 4 year old nearer 4 than 5.

In conclusion, it may be stated again that experience is the essential element in the ageing of a horse and practice should be obtained as often as possible.



Fig. 1.—One year.



Fig. 2.—Two years.



Fig. 3.—Three years.



Fig. 4.—Four years.



Fig. 4a.—Four year mouth when closed.



Fig. 5.—Five years.



Fig. 6.—Six years.



Fig. 7.—Seven years.



Fig. 7a.—Seven year mouth when closed.

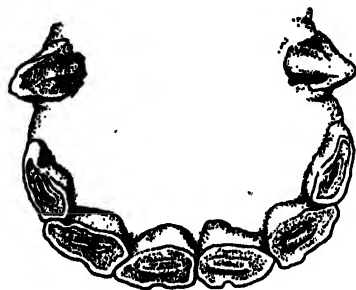


Fig. 8.—Eight years.



Fig. 10.—Ten years.

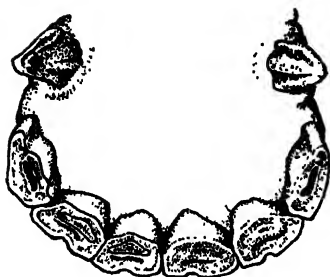


Fig. 9.—Nine years.



Fig. 11.—Eleven or twelve years.

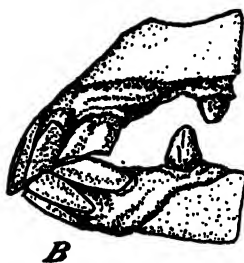
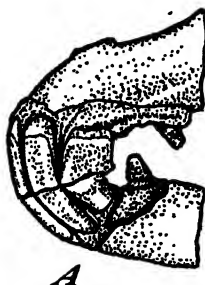


Fig. 12.—Comparison of incisors and rushes at—A. 7 years; B. 20 years

DAIRYING SHIELD FOR LEADING DISTRICT IN DAIRY FARM COMPETITION.

G. K. BARON-HAY,
Superintendent of Dairying.

The Dairying Shield which was presented by Cuming, Smith & Mt. Lyell Farmers' Fertilisers, Ltd., to be won by the district containing the four leading dairy farms entered for the Better Dairying Competition was won in 1933-34 by Zone No. 1, embracing the district from Armadale to Brunswick.

The four farmers who were responsible for their district winning the shield are:—

MESSRS. S. F. Russell, Serpentine.
W. Shaw, Harvey.
G. E. Scott, Yarloop.
S. Bowers, Brunswick.



Reference to Table 1 below, which gives the particulars of stock on the four leading farms in each Zone, will show the very high average production of the cows on the four leading farms in the winning Zone, namely, 313.6 lb. butter fat per cow. Two of the farmers—Messrs. S. F. Russell and S. Bowers—were leaders in their respective Herd Recording Associations, while a third—Mr. G. E. Scott, Yarloop—was the owner of the leading herd in the Pure Breeds Herd Recording Scheme.

TABLE 1.

Particulars of Stock on the Four Leading Farms in Each Zone.

		Av. Butter Fat per Cow.	Av. Butter Fat per Acre.	No. Acres per Cow.	Av. Pigs per Farm.
Zone 1—Harvey	..	313.6	71.9	4.36	*8
Zone 2—Bunbury	..	236.5	44.9	5.27	52
Zone 3—Bridgetown	..	244.0	45.0	5.40	19
Zone 4—Manjimup	..	197.5	40.5	4.90	12
Zone 5—Busselton	..	207.7	50.0	4.20	39
Zone 7—Denmark	..	207.3	70.0	3.00	33

* Whole milk district.

The average butter fat per acre was 72 lb. in the winning Zone, which is considerably higher than that in other districts, except Zone 7, Denmark. However, in Denmark, areas cleared on each farm are small, and the herds are not yet developed fully. In other districts the average production per acre was approximately the same as the average on all farms in the competition, *i.e.*, 43 lb. per acre.

It also will be seen in Table 1 that in the winning Zone the number of pigs per farm is low. This is explained by the fact that many competitors in this area are suppliers of whole milk, and the four leading farmers supply a quantity of whole milk during the year.

In Zone 2, Bunbury, the number of pigs per farm is high and, on all older developed dairy farms, it is noticed that more attention is paid to pig-raising than on newer areas. It also indicates that in this district farmers did not sell their sows during the period 1931-32 when the prices of pig products were low.

In the extreme southerly districts of this State the number of sows on farms at the end of 1933 was approximately half what they were two years previously.

TABLE 2.

Conservation of Fodder on Four Leading Farms in Each Zone.

		Average Acres per Farm.	Hay per cow.	Silage per cow.	Summer Fodder Acres	Irrigated Pasture. Acres
			Tons.	Tons.	per cow.	per cow.
Zone 1—Harvey	..	132	1.52	0.3	0.3	1.2
Zone 2—Bunbury	..	167	2.00	0.6	0.1	0.04
Zone 3—Bridgetown	..	113	2.60	1.1	0.14	—
Zone 4—Manjimup	..	141	1.60	0.6	—	0.33
Zone 5—Busselton	..	94	2.30	2.5	0.16	—
Zone 7—Denmark	..	55	1.20	1.2	1.1	—

Table 2 shows that in the winning Zone 1, special attention has been paid to the conservation of fodder, the growing of summer crops and the provision of green feed generally during the summer months. Although the production of hay is one-half ton per cow below that of the Bunbury Zone, this is more than offset by three times the area of green summer crops being provided, and no less than 1½ acres of irrigated pasture per cow. This ample provision of succulent feed throughout the year accounts in great measure for the average high production of cows in the four leading herds.

The competition was won last year by Zone 2 (Bunbury), and from the improvement noticed in all areas during the three years that the competition has been conducted, both the previous winners will have to make special efforts in order to retain the Dairying Shield which is to be competed for over a maximum of five years.

FEEDING FOR FAT LAMB AND MUTTON PRODUCTION.

(Published by courtesy of the Australian Broadcasting Commission, being an Education Talk given through Station 6WF on 6th April, 1934.)

By DR. E. J. UNDERWOOD,

Animal Nutrition Officer, Department of Agriculture.

There is probably no branch of the sheep industry which can furnish such quick and profitable returns as that of fat lamb raising. More skill and care is required than is usually bestowed on the average merino flock, but the profits obtainable from the right type of lamb produced at the right time are likely to be greater than those from even the most profitable wool types. Under the climatic conditions of the southern portion of this State, fat lamb raising has the further great advantage of enabling the maximum number of stock to be carried in the winter period when feed is most abundant, and a minimum number in the summer when the feed is driest and scantiest.

The first essential in the profitable production of fat lambs is undoubtedly the selection of the most suitable breed of ewe and of ram for mating. The pure merino is quite unsuited for this purpose, as the lamb is slow maturing and of poor shape and quality of carcase. Experiments at the Avondale State Farm and elsewhere have established the fact that the best quality lamb is produced by mating one of the Downs breed of rams with the Merino-Longwool cross-bred ewe. In this State the most profitable returns have usually been obtained by using a Southdown ram on the Merino-Border Leicester ewe. First quality lambs, however, may be produced by using either a Shropshire or a Dorset Horn in place of the Southdown ram, and a Lincoln or English Leicester in place of the Border Leicester ram.

Having decided on his breeding programme, the farmer has two principal aims:—

1. To obtain the maximum "drop," *i.e.*, percentage of lambs from his ewes.
2. To obtain the maximum growth rate from these lambs so as to have them at a marketable size and quality as early as possible.

While breed is of outstanding importance in both these considerations, feed is also capable of exerting a profound influence both on the number and the quality of the lambs produced. Poor feeding may completely nullify the effects of good breeding, while good feeding may greatly enhance the value of even the best breeding.

The influence of feeding on lamb and mutton production is best discussed under two headings:—

1. The influence on breeding.
2. The influence on growth.

1.—Breeding.

The fertility of a female animal depends primarily upon her ability to produce fully mature ripened eggs or "ova," capable of fertilisation by the sperms of the male. If the animal is undernourished, *i.e.*, receiving too little total food, the ova do not ripen properly, and may even degenerate and atrophy even when almost mature. Some degree of degeneration of the ova in the ovary is a normal process, whatever the state of nutrition of the animal, but if the animal is kept in very poor condition, then this degeneration takes place on a consider-

able scale and results in the animal being sterile for the season or at least having its prolificacy reduced.

On the other hand, a condition of adiposity is a very common cause of infertility. Very fat lambs often do not come in season in a very marked way, and when they do so, the periods are apt to be irregular and may be missed, or the animals may fail to breed altogether. A very low fertility associated with many prize animals fattened for the show or sale ring is a well established fact. The condition, if it has not gone too far, can be corrected by muscular exercise and reduction in the quantity of food given.

There is no doubt that, whatever the condition of the animal, **a rising or improving state of nutrition prior to service is the one most favourable to fertility.** This applies to the male animal as well as to the female. It is well illustrated by the successful results in England, brought about by the process of "flushing" of ewes prior to service. "Flushing" consists of supplying additional food of good quality just before mating in order to stimulate ovulation. This results in the production of a larger number of ripe ova available for fertilisation. In animals that are fit, but not overfed, any sudden increase in the feed will stimulate the functioning of the reproductive organs.

Ewes in the southern portion of this State are usually mated in November, just as the natural feed is drying off, and consequently falling off in feeding value. Mating at this time, or later, is essential in most seasons if the ewes are to be lambed down on green feed the following autumn. This means that under the conditions of sheep husbandry most usual in this State, the period immediately prior to service is one of a **falling** state of nutrition for the ewes or the very reverse of that most conducive to maximum fertility. Obviously, for better lambing percentages, the farmer should make some special provision for his ewes at this time, either by turning them into a particularly good pasture kept for the purpose, or preferably a crop such as oats, peas or lupins, or by hand feeding with a little grain or concentrate. This extra feeding or "flushing" should be started 2-3 weeks before mating. It would bring about that rising state of nutrition necessary for maximum fertility and give improved lamb "drops" in farm flocks.

Pregnancy.—Contrary to general belief the pregnant ewe has very little extra food requirements until about the last third of the gestation period. The aim should be to keep her in a healthy, thrifty condition, until about 1-2 months before lambing is due to start, and then to improve the food supply either by suitably feeding or by turning on to a sown crop. The extra food at this time is required:—

1. To provide for the extra requirements of the developing foetus, which by this time have become appreciable.
2. To stimulate the growth of the milk-secreting tissue of the udder. The greater the development of the udder, the greater the capacity of the ewe to produce milk for her lamb.

The process of giving extra food of good quality a few weeks before the birth of the young so as to stimulate udder development is known as "steaming up," and is used very effectively in England in the dairy industry. It could be used equally effectively in this State in the fat lamb industry where the capacity of the ewe to produce milk is of supreme importance.

In a season such as the present the very good **early** rains will ensure a good growth of young pasture and sown crops, but usually ample hand feeding in April and May is essential for this purpose.

2.—Growth.

After lambing an adequate food supply for the ewe is essential, because for the first 3 months the growth rate of the lamb is directly dependent on the quantity of milk given by the mother. Experiments have shown that the quantity of milk available to the lamb is just as important as inherited capacity for growth, i.e., breed. In fact, part of the better growth rate of certain breeds is due to the larger milk yield of the mothers. An average ewe yields from $2\frac{1}{2}$ -4 pints of milk daily or $2\frac{1}{4}$ - $3\frac{1}{2}$ gallons a week, and the milk is richer than cow's milk, so it is obvious that the food requirements of the milking ewe are very high. It is very necessary for the ewe to have an ample supply of highly digestible food rich in protein and phosphate. The food requirements of lactation are very much higher than those of pregnancy.

In some seasons a certain amount of young green pasture of high feeding value may be available to the lambing ewes by May, but the amount is usually small and normally natural green feed is not plentiful until late in June. If the fat lambs are intended to export, they should be dropped early in May so that fodder crops must be grown to supply the necessary green feed for the ewes. For this purpose the farmer could not do better than sow an early variety of oats or barley, oats and peas, or oats and rape on well prepared fallow with the first rains. These crops come away very quickly and can be grazed heavily, and normally will ensure an ample supply of succulent feed for the lactating ewe. If, as in 1933, the autumn rains are very late, then hand feeding with conserved fodder such as silage or early cut hay with a little oats, peas or linseed are essential if the ewe is to keep up her milk supply and induce the optimum growth rate in her lamb.

For the highest quality product farmers should aim at selling as large a proportion as possible of their lambs "fat off their mothers," preferably at the age of 12-15 weeks. The success of a farmer in fat lamb raising will depend largely on the time and the extent to which he can do this. There will always be a certain percentage of late or unsuitable lambs, however, and the farmer has to decide whether to sell these at lower rates or to keep them for sale as hoggets the following year. If they are to be kept, then provision must be made for feeding them well, particularly just at weaning time and during the summer months, so as to sustain those qualities of carcase for which they have been bred. Suggestions for the summer feeding of young growing sheep have been made in a previous article ("The Summer Feeding of Sheep," by E. J. Underwood, this Journal, Vol. VI., March, 1934), and the necessity for keeping up a high plane of nutrition both to minimise the effects of worm parasites (to which weaners are particularly susceptible) and to sustain normal growth rate was there pointed out.

Summary.—The most important points to be considered in feeding for fat lamb production are:—

1. Have the ewes in an improving state of nutrition at mating time by giving extra food, or turning on to specially good grazing 2-3 weeks prior to mating. Giving of extra food at this time is known as "flushing" the ewes.
2. Keep the ewes in a thrifty condition during pregnancy, with extra food a few weeks before lambing. This is the process of "steaming up."
3. Ensure a good milk supply for the lambs by turning the ewes on to crops such as oats, or oats and rape sown on fallow with the first rains. When the rains are late ample hand feeding must be carried out as the food requirements of the milking ewe are very high.

SUDAN GRASS.

(*Sorghum sudanense*, Stapf.)

G. K. BARON-HAY,

H. G. ELLIOTT,

G. R. W. MEADLY.

Confusion still exists regarding the nomenclature of Sudan grass. Some botanists regard it as a separate species under the name *Sorghum sudanense*, Stapf., while others consider it only a variety of Johnson grass (*Sorghum halepense*, Pers.) owing to the comparatively slender distinctions between the two grasses.

Sudan grass is a native of Africa but has been introduced into many other countries as a summer growing fodder crop.

Description.—An annual or sometimes biennial grass. Culms rather slender up to 10 feet in height. Leaves numerous, about 18 inches long and half-inch wide. Leaf blade convolute in the bud, ligule membranous. Panicle ovate or pyramidal, from six to 12 inches long, and about half as broad at the base. Branches whorled, loose and spreading from the central rachis.

Spikelets of two kinds—one sessile and the other peduncled, those of each pair differing in sex and shape. Sessile spikelet 6-7 mms. long, dorsally compressed, readily deciduous at maturity, together with the peduncled spikelet or at least its peduncle. Peduncled spikelet staminate, narrow. Glumes of sessile spikelet equal, coriaceous, the lower with a broad flattened or convex dorsal surface, the upper boat-shaped. Lemma elliptical to lanceolate, usually glabrous. Grain obovoid, dorsally compressed.



Sudan Grass under Irrigation. L. Temple, Harvey, 1933.

Sudan grass was first introduced into Western Australia in 1918 when trial plots were established at the Merredin and Chapman Experiment Farms, which gave very promising results.

In 1919 no less than 135 farmers were supplied with seed by the Department, the good results from which did much in popularising this plant.

Sudan grass is a highly drought-resistant, summer-growing annual, which matures fairly rapidly and often under ideal conditions the first crop is ready for cutting or grazing six to eight weeks after seeding. Under irrigation three or even four grazings can be obtained during the season.

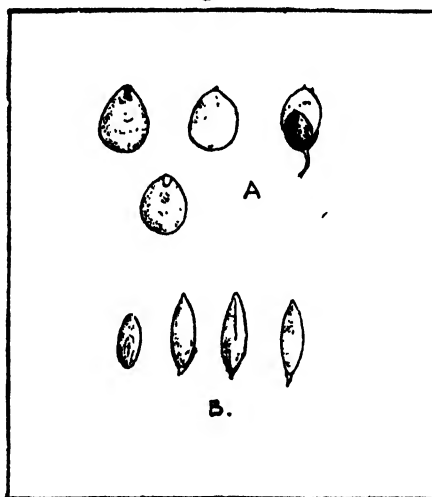
Several factors are essential for the successful cultivation of this grass, and the following information has been prepared to assist farmers wishing to grow this crop.

Soil Requirements.—Sudan grass gives best results when grown on a rich well-drained loam, naturally moist, or where irrigation is available. It, however, has been grown successfully on many types of soil from heavy clay to light sand. Deep light sandy soils are usually disappointing unless enriched with a nitrogenous fertiliser, and supplied with ample moisture.

Preparation of Seed Bed.—The ground should be fallowed as early as possible in the spring to kill weeds, promote nitrification, assist in warming the ground and conserve moisture.

The ideal seed bed is one which is firm and covered with 1 to 1½ inches of loose surface soil. This can be produced by cultivation and harrowing to kill weeds, both after ploughing and prior to seeding.

Diagram I.



A.—Milo Sorghum Seed.

B.—Sudan Grass Seed.

Rolling the land after cultivation and prior to seeding has given good results, but care should be taken to harrow or cultivate lightly after rolling, so as to form a mulch on the surface.

The importance of a good seed bed cannot be stressed too much, as the plant in non-irrigated areas must rely almost entirely on the conserved moisture for its germination and subsequent growth.

Seed.—All growers should be sure that their seed supply is pure. The seed should be of the highest purity and germination and be free from Johnson grass or seeds cross-fertilised with the other sorghums. Sudan grass, being a sorghum, will cross-hybridise very freely with other members of the group, such as Kaffir corn

or milo. These hybrid plants among Sudan grass probably give rise to occasional reports which are made regarding mortality in stock feeding on the crop.

Good seed may be ensured by buying from some reputable source of supply and undertaking an examination of the seed for these sorghum strangers. These may be recognised by their being more or less rounded in shape, whereas Sudan grass seed is flatter, more elongated, and somewhat pointed at the ends. (See Diagram No. I.)

Under the Agricultural Seeds Act, farm seeds are required to be sold with a guarantee of germination and purity. A good sample should have a germination of about 88 per cent., and should not contain more than two per cent. of weed seeds and impurities by weight. By demanding such a guarantee when purchasing seeds, farmers will do much to raise the standard of agricultural seeds.

The weed and other foreign seeds of most frequent occurrence in samples of Sudan grass are:—

Datura stramonium (Thorn Apple).—All parts of this plant are poisonous, especially the seed.

Xanthium spinosum (Bathurst Burr).—A noxious weed.

Chenopodium album (Fat Hen).—Of value as a sheep feed.

Sorghum vulgare (Sorghum).—May be dangerous where the plant is grown for grazing.

Sida retusa (Sida Weed).

Polygonum convolvulus (Black Bird Weed).

Setaria sp. (Millet).

Rate of Seeding.—Unless care is taken to purchase only seed with a high percentage of germination, disappointing results will ensue in districts where only a light sowing is recommended, and definite advice as to the quantities to sow per acre may be misleading.

The following "real value" of five samples of Sudan grass seed examined by the Economic Botanist and Plant Pathologist, and reported in the September, 1925, issue of the *Journal*, demonstrates this.

—					Purity.	Germination.	Real Value.	Viable seeds in 10 lbs. seed
					per cent.	per cent.	per cent.	lbs.
Sample	A	...	...	...	99.4	81.0	81	8.1
"	B	...	...	...	96.8	38.7	38	3.8
"	C	...	...	...	98.8	51.0	50	5.0
"	D	...	...	...	84.8	58.5	50	5.0
"	E	...	...	...	71.2	74.0	53	5.3

Obviously, therefore, in a district where 3 lbs. of seed per acre is recommended, Sample "A" would give a good crop, whereas Sample "B" would undoubtedly prove a failure, other conditions being the same.

Recommendations, therefore, can only be made for samples reaching the standard laid down above.

Competitions have shown that it is preferable to sow light quantities of seed per acre where the annual rainfall is low, i.e., 16 to 17 inches, and to increase the quantity for districts with a higher rainfall.

DISTRICTS WITH ANNUAL RAINFALL.

—	17 inches or under.	18-23 inches.	24 inches or over.
Quantity Sudan Grass seed per acre	3 lbs.	6 lbs.	10 lbs.

Illustration 2.



1920.

1919.

Showing the Value of Seed Selection.

Method of Seeding.—Sudan grass seed may be either broadcast or sown through a drill.

Broadcasting should not be practised except in districts with an ample rainfall, and the quantity of seed per acre should be increased by one-half over that recommended above.

Unless a broadcasting machine, such as the "Cahoon," or a grass-seeding attachment to the ordinary drill be employed, it is difficult to get an even distribution, which is desirable.

Where hand broadcasting is necessary, a good plan is to mix the seed with a quantity of dry sand or ashes, so that the small quantity of seed per acre may be more easily applied. The usual method, however, is to mix the seed with the fertiliser immediately before seeding, and broadcast the seed with the manure.

Sudan grass, however, is best sown with the drill, mixing the seed with the fertiliser used, and sowing within twenty-four hours.

Illustration 3.



J. M. Riegert, Yarloop. Sudan Grass in the "Wm. Padbury" competition. Yield 7 tons 18 cwt. per acre.

In dry districts some farmers prefer to close up alternate tubes of the drill so as to sow the seed in drills about 14 inches apart, but good results have been obtained in all districts by sowing through every tube, provided seed is not applied too thickly.

There is considerable difference of opinion among farmers as to the wisdom of mixing Sudan grass seed with superphosphate prior to seeding. Mr. J. M. Riegert, Yarloop, who annually grows a considerable area for seed, and has won the Royal Agricultural Society's competition, always mixes the seed with superphosphate, but has found that it is unwise to leave the seed in the manure for more than 24 hours. Mr. G. C. Hodges, Yornaning, who has also grown Sudan grass for a number of years, believes that superphosphate has little effect in damaging the seed.

Work carried out to test the effect of superphosphate on certain small seeds has shown that freshly made superphosphate or damp superphosphate is far more dangerous than the dry fertiliser; also that the deleterious effects of superphosphate is not so great on the smaller grass seeds, which are generally covered with a "husk," as on "naked" seeds, such as rape or kale. The writers believe that, by mixing only enough seed with the manure as will be required for the morning or afternoon's sowing, no harmful effects to the seed will be experienced.

Depth of Planting.—With Sudan grass as with all spring sown crops, deeper planting than is ordinarily practised would be beneficial on loamy or sandy soil. The reason for this with little reflection will be obvious.

All these crops should be sown on well prepared "fallow" which should possess a fine surface mulch.

In light soils this mulch is generally at least two inches in depth and is dry. In order to obtain successful and rapid germination, it is necessary for seeds to be planted just below this mulch and in contact with the damp under soil. Where planted with a drill and not followed by a roller, the ordinary depth practised with wheat has given good results.

The moisture may be brought nearer to the surface by rolling, but the soil should be harrowed immediately after planting is completed, in order to prevent undue loss of moisture.

Illustration 4.



A head of Sudan Grass compared with heads of Sorghum and Sorghum-hybrids. On the left—Sudan Grass; Centre—Hybrid plants; on the right—Sorghum.

(N.S.W. Journal of Agriculture.)

Manures.—Sudan grass is a rapid grower and, therefore, will require supplies of easily available plant food. By fallowing the land intended for this crop, usually enough soil nitrogen is produced by the process of nitrification to supply the needs of the plant.

In some districts good results have been obtained with 1 cwt. superphosphate, and at least this dressing per acre is recommended, though heavier dressings may be employed profitably where conditions for moisture conservation are good or irrigation is available.

On irrigated areas 2 cwt. of superphosphate and ammonia No. 3 (superphosphate 2½ parts, sulphate of ammonia 1 part) per acre is recommended.

Time to Plant.—Sudan grass will not germinate in a cold, badly aerated soil, and therefore the date of planting in the spring will vary for different districts of the State. It should not be planted until all danger from frost is over, and the ground warm. This will vary from September in the wheat belt areas to early November in the extreme south-west portions of the State.

Feeding Sudan Grass.—Sudan grass may either be utilised as a green crop or fed as hay. It is in the former condition that this crop is of special value in Western Australia.

All the sorghums, of which Sudan grass is a member, contains a glucoside capable of yielding prussic acid on fermentation. This glucoside is present in the sorghums in dangerous quantities up to the time the plant is forming seed. Sudan grass, however, has not been proved to contain sufficient quantities of this poisonous principle to be dangerous at any time in its growth, and, unless sorghum or sorghum-Sudan grass hybrids are present in the crop, it may be taken as safe for grazing with stock.

Analyses of Sudan grass in this State have shown the entire absence of this cyanogenetic glucoside, while American analyses have shown that a cow or horse would have to eat 155 lbs. of fresh Sudan grass in one feed to obtain a lethal dose. This is almost an impossibility. It is a wise precaution, therefore—before turning stock on to Sudan grass—to walk through the crop and note the prevalence of hybrids and sorghum plants, which may be distinguished by the broad leaves, coarse thick stems, and—if in the head—the short compact heads. Hybrids may show any variation between the true sorghum heads and the very open heads of true Sudan grass. If these plants are in any quantity, the crop should not be fed off until the plants are well in head. If only a few undesirable plants are present, they, of course, may be removed. The seed from such a crop should not be reserved for planting purposes the following year.

Sudan grass compares favourably with maize by analysis, although, as usually grown in this State, the yield per acre would not be so great.

	Water.	Ash.	Crude Protein.	Carbohydrates.		Fat.
				Fibre.	Nitrogen free extract	
Sudan Grass ...	63.91	3.1	2.0	8.4	21.5	1.1
Maize ...	76.9	1.2	1.9	5.5	13.9	0.6

Although a considerable number of feeding trials have been carried out to determine the digestibility of maize, only a few trials have as yet been carried out with Sudan grass in this direction. Such trials, however, have indicated that Sudan grass is relatively very palatable to stock, and has a digestibility of the order of maize.

To this must be added the undoubted value of the grass as a laxative and tonic during a period of the year when no other green material is usually available. Because of this effect on stock, care should be taken not to turn stock which have been living on dry feed suddenly on to green Sudan grass. Stock should be accustomed to the change of diet gradually by allowing them to stay on the Sudan grass only for a short while during the first few days.

Sudan grass makes excellent hay, and good yields may be secured. Mr. A. G. Paterson, Piesse, obtained over one ton per acre in one cutting from about 90 acres, while Mr. J. M. Riegert, Yarloop, reports yields as high as three tons of hay per acre in one cutting.

In addition to the hay crop further grazing is obtained, and the feeding value is good, as shown in the following comparison with oaten hay:—

DIGESTIBLE NUTRIENTS PER 100LBS.

	Protein.	Carbohydrates.	Fat.
Oaten Hay	3·8	43·7	1·6
Sudan Grass Hay	3·3	53·4	0·9

The cultivation of Sudan grass offers an opportunity for supplying the luscious feed so necessary to milking stock in the summer, and owes its drought resistance mainly to its power of rapid growth. It has been noticed to head in 55 days, and illustration I. shows a crop well over five feet in height only seven weeks from time of planting.

Sudan Grass Poisoning.—As a certain amount of doubt still exists in regard to the reputed toxic properties of Sudan grass, the following statement, which appeared in the June, 1934, issue of the "Journal of Agriculture," is reprinted.*

"Sudan grass, when free from hybrids, is not likely to be dangerous at any stage of growth but has the greatest risk where the grass has been stunted by frost or dry conditions. Any risk is minimised by wilting for twenty-four hours prior to feeding.

"If cattle are to be grazed on Sudan grass, care should be taken that they are only put on it for a short time at first, particularly if they are hungry. Sudan grass is as likely to cause hoven or bloat as any other succulent forage.

"These conclusions are in conformity with local experiences."

* Journal of Agriculture, W.A., June, 1934:—"Sorghum, Sudan Grass and Johnson Grass Poisoning."—G. R. W. Meadly.

POWDERY MILDEW ON ROSES.

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This disease is caused by the fungus known as *Sphaerotheca pannosa*, another name for which, in the conidial stage, is *Oidium leucoconium*, whence the common name "Oidium" for this disease. The trouble can be recognised by the occurrence of dusty, whitish, patches on leaves, stems and flower buds. Considerable distortion of foliage may occur and badly affected plants are rendered very unsightly. The quality of the blooms is considerably lowered following the reduction of the vitality of the plant, and flower stalks attacked by the fungus become weakened and may allow the blooms to droop badly.

During the spring and autumn, oidium is very common in most years on numerous varieties of roses. Its prevalence at these seasons of the year is due to the fact that the fungus requires a warm, moderately moist, atmosphere in order to develop successfully. It occurs most commonly on roses growing in shady, moist situations, and on plants that are frequently watered on the foliage and other above-ground parts with a sprinkler or hose.

CONTROL.

Roses should be grown, wherever possible, in a position where they will receive the full force of the sunlight during the whole of the day.

Drainage, if defective, should be improved; also, as indicated above, the frequency of watering should be reduced to a minimum. Heavy, but infrequent, waterings should be the guiding principle. On most occasions the water should only be applied to the soil in which the plants are growing, and not to the leaves. Frequent light waterings with a sprinkler or hose on the foliage are especially "taboo."

During warm weather, dusting the plants with "flowers of sulphur" is advantageous. The sulphur can be distributed by placing it in a bag of hessian or other material of similar texture and shaking the bag over the plants, or it can be applied by means of a special sulphur bellows or dust-gun. The sulphur bellows or dust-gun facilitates treatment of the under-sides of the leaves. A suitable machine can be purchased quite cheaply from any general storekeeper. Sulphuring should be done in the early morning, when the dew on the foliage helps the sulphur to adhere. In the heat of the sun, according to one theory, the sulphur is volatilised and the fumes destroy the fungus. It may be necessary to repeat the sulphur treatment every seven days or so until the advent of very hot dry weather.

Do not apply a very heavy deposit of sulphur, or scorching may occur during very hot days. When each dusting is finished, there should only be a thin film of sulphur, barely perceptible to the naked eye, on the plant.

Because of the ease with which sulphur can be displaced by wind and water after it has been applied to plants, some gardeners prefer to spray with the proprietary preparation known as "lime-sulphur," at the rate of one part by volume of "lime-sulphur" to 50 or 60 parts by volume of water. The "lime-sulphur" treatment is very effective if it is done properly, and it is much longer lasting than the sulphur dusting. It should not be applied during the heat of the day or during very hot weather, or scorching of the leaves, etc., may result. If used in the summer, 1-100 is the best strength. The shade temperature should be below 75° when the spray is applied. Flour may be used as a spreader. One pound should be added to each ten gallons of spray. The flour should be mixed with a little cold or hot water to form a paste and then added to the diluted spray. Calcium caseinate may alternatively be used at the rate of 1 lb. per fifty gallons of diluted spray (*i.e.*, for smaller amounts use calcium caseinate 1 oz. per 3 gallons of spray. If flour is used, take 4 ozs. per 2½ gallons of spray).

A third method, to be recommended when the plants have been neglected and, therefore, become badly affected, is to spray with a Condry's crystals solution (one ounce of crystals, plus one ounce water glass and one-third ounce of baking soda to five gallons of water). Treatment with Condry's solution will completely clean up an attack of mildew; but the effect is not very lasting and it is advisable to follow with sulphur dusting as soon as the spray has dried off. Repeated spraying of plants with a solution of Condry's crystals has, however, a quite remarkable effect upon the general vigour and tone of the plants. The foliage becomes a darker green and the growth of new shoots and buds appears to be stimulated very considerably. (Instead of "Condry's crystals," potassium permanganate may be used, at the same rate.)

"Livers of Sulphur" may be used to control mildew at the rate of one ounce per two gallons of water.

Heavy manuring with sulphate of potash confers considerable resistance to the mildew and also to lime sulphur injury. Over-manuring with nitrogenous compounds makes the plants more susceptible to the disease by stimulating a soft succulent type of growth.

LOCATION AND MANIPULATION OF APIARIES.

H. WILLOUGHBY LANCE,
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Success in beekeeping depends on many factors. To be successful, a beekeeper must take to it naturally, from a love of the bees and interest in their work. He needs patience and a capacity for taking pains and working systematically. He should study the flora of his district and know when the various flowers and trees may be expected to blossom.

His hives should be strong, well-made and well-kept. The bees should be of a good race and strain, and strong in numbers.

1. Location of Apiary.

The selection of a suitable site for an apiary is the first and most important consideration for any beekeeper, be he a one-hive man or the large commercial apiarist. There are some sites which will only produce a profitable surplus of honey every second or third year. Other sites will produce a fair average every year, but the quality in flavour and colour will be poor. Generally speaking the sites that produce a first class commercial honey will only produce this every second or third year. This means that the apiarist desiring to secure a good annual income from his bees must have several sites in view, and be prepared to move his bees to the best source of nectar. There are, however, many districts where it is possible to secure enough honey from a few hives to keep the family in honey, and often supply neighbours as well, without moving the bees.

Hives are best placed on a slope facing the morning sun, sheltered if possible from strong winds and the hot afternoon sun. They should not, however, be placed in a damp place or where they will not get the morning sun.

In selecting a district for keeping bees the intending apiarist should first make himself acquainted with the blossoms visited by honey bees for nectar and pollen. He should then find out if such trees or vegetation exist within two or three miles of the proposed site. He should also ascertain if there are many colonies of bees within the district, otherwise overcrowding may take place and the newcomer will not only spoil the harvest of those already there, but obtain a poor return himself.

As regards the distance bees will fly for nectar and pollen, it has generally been considered that the bees seldom flew more than two or three miles. Recent experiments, however, prove that bees will gather both nectar and pollen from a district

8.5 miles from the hive. In these experiments it was shown that the colonies half to two miles away from the source of nectar made greater gains than those within half a mile, while beyond the three mile point returns showed a proportional decrease as the distance increased. This confirms the previous belief that two miles is a profitable bee radius.

2. Government Sites and Registration.

Apiary sites on Government land under the control of the Forestry Department may be obtained on application for £2 per year. This gives the apiarist a radius of two miles' bee range from the site and means that no other site will be let closer than four miles. Application for sites should be made to the Forests Department, Perth, from whom full particulars can be obtained.

Sites can also be leased from the Midland Railway Company on similar conditions. Applications should be made to the Midland Railway Company, St. George's Terrace, Perth.

Under the terms of the Bees Act, 1930, all owners of apiaries must register their apiary with the Department of Agriculture, Perth. For the purposes of the Act any place where one or more hives of bees are kept or any place where used beehives or apparatus are kept is an apiary. Penalty for non-registration £5. Application for registration is to be made to the Department on the prescribed form, the fees being 1s. for from one to ten hives, over ten hives 2s. 6d. The fee is not annual.

The purpose of the registrations is to ascertain where bees are being kept, and to enable the Department to prevent the spread of infectious diseases. Apiarists can obtain literature on beekeeping free of charge.

3. Hives.

Box hives without frames are useless for the gathering of honey and are not allowed under Section 12 of the Bees Act, 1930. They cannot be examined and are breeding places for disease and moth.

Some men have standard frames and hives, but have neglected to put wire and foundation into the frames, and the expenditure on frames is worse than useless, as the bees have built the combs anyhow across the frames, which cannot be removed without breaking the comb. Sometimes the frames are fitted with starters or even full sheets of foundation, but owing to the hives not being level the frames do not hang plumb and the combs are built across two frames or, due to the hereditary tendency of some bees to build irregular comb, the combs are built anyhow, and the expenditure and labour are useless.

Another type of hive is the home-made one with incorrect spaces due to the ignorance or indifference of the owner to the habits and methods of bees.

In some of these hives the covers and frames are stuck so tight with propolis that they break before they can be removed, or there is so much unnecessary space, that there is extra comb which has to be broken or cut before the cover or frames can be removed. Beekeepers should remember that the natural working space of the bee is $\frac{1}{4}$ inch. If the space is less than $\frac{3}{16}$ th of an inch, the bees will fill it up, if more than $\frac{5}{16}$ th of an inch, they will probably build comb therein.

A previous issue of the *Journal* contained an article on "Bee Hives." This has been reprinted in leaflet form and can be obtained from the Department of Agriculture. The number is 308. It contains particulars and sketches of a home-made hive including a cover or roof which is cheap and more serviceable than most of those seen about apiaries.

4. Combs and Frames.

Good combs and frames are of utmost importance and the beekeepers are advised to obtain leaflet No. 383 on this subject.

5. Bees.

In all primary industries the importance of not only having the best breeds of either seed or livestock, but also of having the breed most suitable to the conditions of the district, has never been so fully realised as at the present time.

In view of this generally acknowledged fact of the importance of good blood, it is surprising to find a large number of bee-keepers who appear to be indifferent to it. In going about the country, one finds very few men who have a really first class bee; they may have a few good colonies, but they do not breed from these, nor do they purchase new pure bred queens. They let nature have its way, allowing the bees to swarm and to re-queen themselves. This method in bee-keeping, as with poultry or any other live stock, tends to the deterioration of the stock.

Selection and breeding from selection is the only way to get the best results, reduce production costs, and enable the farmer, be he bee farmer or other, to meet competition and earn a comfortable living.

Of course this is not the only factor upon which success depends. The general method of conducting the work of the farm is most important, and then there are so many factors over which the farmer has no control, such as the weather, forest fires, etc. This, however, is a certain fact, that in a good season, with a good honey flow, any colony of bees that is fairly strong, will probably do well, even if badly neglected by the owner. But when circumstances are against the industrious bee everything depends upon the strains from which the bees have been bred. Bees from a good stock will survive and perhaps store a surplus, while the indifferent ones will go under. Practically all successful bee-keepers are careful to re-queen every colony at least every two years, and some every year, or even less if the queen does not deliver the goods.

Some bee-keepers breed their own queens from their best colonies, others consider that it pays them better to concentrate on honey production and leave the queen breeding to the expert.

The Department, recognising the importance of good stock, has imported Carniolan queens from Jugo-Slavia, and queens bred from these can be obtained from the Department of Agriculture.

It is claimed for the Carniolan that they are a longer lived bee than the Italian, that they are hardier and will work in weather that keeps the Italian at home, and that they build beautiful white comb and are quiet to handle.

A longer lived bee means a smaller proportion of brood to that of adult bees than would be the case with short-lived bees. That, again, means less food to be consumed by the nurse bees to make chyle food for the larvae. It is usually considered that the life of the average worker bee during the honey season is about six weeks. Assuming workers that will live eight weeks instead of six can be obtained, 25 per cent. of the food required for brood raising will be saved. For instance, assume that we have a hive of 30,000 bees. With our average bee this would require the hatching of 5,000 bees per week to keep up the population of the hives, or 120,000 bees in six months. With a bee living eight weeks, only 3,750 bees would require to be hatched per week, or 90,000 in six months instead of 120,000. We thus realise what an immense saving there would be in food. Leaflet No. 331, dealing with the "Carniolan Bee" can be obtained free from the Department.

6. Ants and Stands.

In some districts ants are a great pest, not only attacking bees that alight on the ground, but climbing the hive and entering therein; the small sugar ants frequently making their nests between the quilt (where these are used) and the cover. That is one reason why the use of quilts is not recommended. It is far better to have a bee space of $\frac{1}{4}$ in. between the tops of frames and the cover.

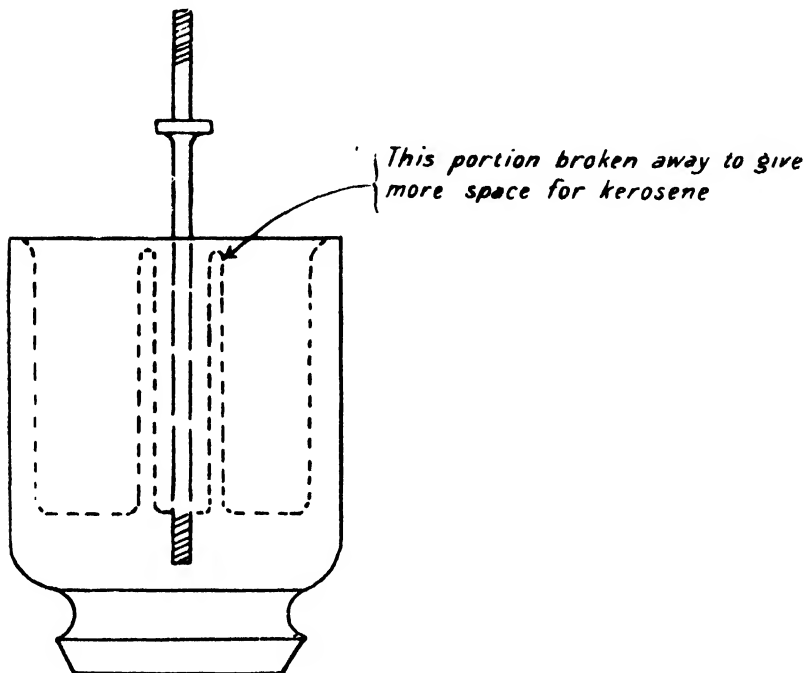


Fig. 1.

The larger types of ants, particularly the Meat Ant (*Iridomyrmex detectus*) attack the hives and cause large numbers of bees to stay home to defend the entrance.

If nests can be located, bi-sulphide of carbon, sheep dip, or cyanogas are good substances for destroying them. A hole, several inches deep, according to size of nest, should be made in the centre, and a quantity of one of the above substances put therein, and the hole covered up. If the nests cannot be located or are too numerous, a good ant-proof stand may be made with the aid of old telegraph insulators. Four pieces of 3 x 2 inches timber are nailed together to make a rectangle the size of the hive, and four inverted insulators let in to the corners underneath. These should be of the hollow type, and the inside collar of china broken away (see Figure 1). This space will now form a cup, which is filled with kerosene or old motor oil from the sump.

If there are a large number of hives, stands to carry three hives are very convenient, and only six insulators need be used instead of 12. If the stand is made nine feet long, this will allow spaces between the hives for placing supers, etc., when manipulating. The insulator legs should be placed directly under the hives, and as these are frequently screwed on to the metal shanks, they can be screwed up or down to adjust the stand to a level. (See Figure 2.)

If old insulators are not obtainable, the legs of the stand may be made of jarrah and stood in the bottom of petrol tins cut down to about 3 inches and filled with old engine oil.

7. Strong Colonies.

The first object of all beekeepers should be to build up strong colonies. The aim should be two 10-frame body boxes boiling over with young bees. It is still the aim of many beekeepers to make a show with a large number of hives, perhaps thinking that means a lot of honey. No greater mistake can be made. A lot of hives frequently mean no honey, whereas a few strong hives mean

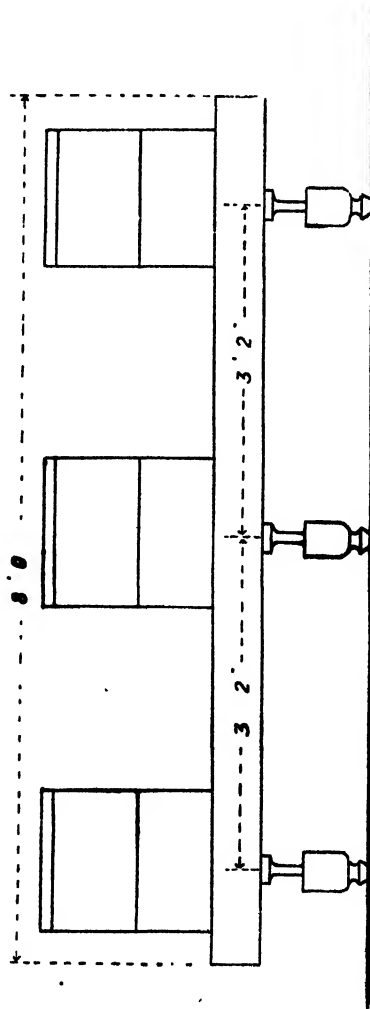


Fig. 2.

plenty of honey and less work. This is realised to such an extent in the United States of America and England that many beekeepers are using 12-frame hives with deeper frames. At the present stage of beekeeping here, this is not recommended, except in special cases, with experienced beekeepers, but every beekeeper is advised to aim at two full-depth bodies packed with bees. Then with a

good honey flow such colonies will fill two or even three honey supers. A good well-bred queen can easily keep these filled with brood during an average season. Cull your queens, and if you have any duds replace them with good stock. Who would be content with a hen that laid one egg per week when he can have one that will lay six or seven. Yet that is what many beekeepers have in the way of queens--those that lay only four or five hundred eggs per day instead of one or two thousand.

8. Transferring.

Many small beekeepers without much experience find it difficult to transfer bees from box hives to frame hives, or from frame hives with a mass of cross combs to new frame hives. For their benefit, particulars of how best to do this are given hereunder.

The transfer should take place, if possible, while there is honey coming in, but it may be done at any time, provided the bees are fed plentifully with sugar or honey syrup after the transfer has taken place. The easiest way of feeding is to obtain a press-top tin, such as is used for honey or golden syrup. Punch a dozen or two small holes in the lid and fill with the syrup.

A quilt made of ticking, sacking, or similar material should be placed over the frames and a hole cut in the centre not larger than the size of the tin. The tin of syrup may now be inverted over the hole; the bees will then suck the syrup through the holes. An empty super or box should then be placed on top to cover the tin, and the cover of the hive replaced. At least eight or 10 lbs. of syrup should be given to each hive to enable the bees to build the new comb and lay up a store for breeding.

A syrup may be made for this purpose from sugar, using 10 lbs. sugar, 5 pints water, 1 oz. vinegar, $\frac{1}{2}$ oz. salt. Boil for a few minutes and feed to the bees whilst warm. To make honey syrup, dissolve about 2 parts of honey in 1 part of water. If honey is used, the beekeeper should be quite certain that this does not come from a hive that may have disease, as honey is the principal carrier of foul brood.

To transfer bees from the old box to the new hive, take the box hive and place on the ground upside down so that the bottoms of the combs are exposed, place bricks or blocks of wood under one end of box to give a slope; place the new hive fitted with frames and full sheets of foundation on an empty box so that front edge of floor touches the highest end of box hive; draw body of new hive forward to project over floor about $1\frac{1}{2}$ inches.

Drum sides of box and give a little smoke at lowest end. Bees will then run up highest end of box on to floor of new hive. When nearly all the bees have left the box, the combs of honey can be cut out, some of which should be fed back to the bees after they are in their new hive; the combs of brood should be tied with string into frames and put into centre of new hive.

To transfer bees from hive with cross combs.—The method adopted may be similar to that with box hives, but in this case it may be impossible to cut out the combs of brood, and tie into frames. It should therefore not be adopted unless the hive is very strong with bees and there is a good honey flow.

Another method which may be adopted with both box hives and hives with cross combs when the above are not suitable or easy, is to place the box or old frame hive on top of a new hive fitted with frames and full sheets of foundation, making sure that the only entrance is through the new hive.

As the brood in the old hive hatches out and honey comes in, the bees will fill the empty cells with honey and force the queen down into the new hive. When

upon examination it is found that the queen is in the bottom, or new hive, a queen excluder should be placed over it to prevent her again going to the top box. Four weeks later all brood in the top box will be hatched out, and it may then be removed.

The drawback with this method is the time it takes, as the queen will not be forced down until there is plenty of honey coming in.

9. Re-Queening.

Frequent inquiries are received as to how to re-queen, so a few notes on the matter are given. Of course, the first thing to do is to catch and kill the old queen, otherwise the young one will undoubtedly be killed. The usual process is to lift out the combs one by one and examine until the queen is found. It is handy to have a spare body near the hive so that the frames, as they are examined, may be placed therein; otherwise while one comb is being examined the queen may pass from an unexamined comb to one that has been examined and replaced, and thus she will be missed. If all combs have been examined and the queen not found, carefully examine the floor board and sides of the hive, then re-examine the combs as they are replaced. If she cannot be found another method may be adopted.

Remove the hive some 10 yards away in front of, and with the entrance facing, the old bee stand. Place an empty hive on old position. Now place a white sheet or piece of newspaper in front of the empty hive and an entrance guard over the entrance, open the old hive, take out two or three combs of brood and examine for queen. If not found, shake most of the bees on to the sheet, examine again, and if the queen is not found, place these combs in new hive and fill up the space with empty combs on sheets of foundation. All flying bees will now return to the new queenless hive. Examine bees on sheet, take several of the remaining combs and shake bees off on to the sheet, examining bees after each shaking for the queen, then replace combs in old hive. If queen has not been found, close up the hive and leave until next day. In the meantime large numbers of bees will have sought their old stand and entered the new hive. As the number of bees in the old hive will now have been much reduced, it should not now be difficult to find the queen. This having been done, all the old combs and bees may be transferred to the new hive; or the old hive can be replaced on its old stand and the combs and bees in new hives transferred to it.

The queen having been disposed of, the usual method is to leave the hive queenless for a day, then taking the mailing cage in which the queen has been received, remove the cork or corks and also remove one frame from the hive and wedge the cage in the centre between the remaining frames. In the course of a few days the bees in the cage and those outside will have eaten away the candy and the queen bee released. By this time she will have the scent of the hive, and will be accepted.

Other methods of introduction are—

1. Smearing the queen with honey and placing her directly between the frames.
2. Wetting the queen with water and placing directly between the frames.

Both these methods depend upon the instinct of the bees to clean up the honey or water; by the time this is completed the queen and bees will have the same scent, and the queen will be accepted. Mr. Bartly, of Tasmania, claims that he has been successful with the water method in 98 per cent. of the introductions. His method is to wet the queen by placing her in a short glass tube partly filled with tepid water, shake the tube to and fro, pour off the water and allow the queen to walk down amongst the bees after giving a puff of smoke.

Yet another method which has been recommended to me, and which has been used with complete success, is the paper bag method. Take a small thin paper bag, such as is used for lollies, place the queen to be introduced therein, without any of her attendant bees, then catch half a dozen bees from the hive and place them in the bag with her. These bees should, if possible, be young and filling themselves with honey from the cells when caught. Although the queen is strange to them, they will be so busy trying to get out that they will not take any notice of her, and in the meantime they will all get the same scent. Remove one frame and place the bag in the hive between the frames, and in the course of a few hours the queen will have been released and accepted. The advantage of this method is that there is no need to leave the hive queenless for a day, and the period they are without a queen is so short they do not start queen cells. I have opened a hive, destroyed the queen, and introduced a new one in a paper bag straight away with considerable success.

Whatever method is adopted, the hive should not be disturbed for about three days, after which time it should be opened to see that the queen is "O.K."

Leaflet No. 387 gives further details for catching and introducing queens.

10. Pollen.

As has already been mentioned, apart from honey, the future generation of the hive depends upon a supply of pollen. Pollen is the reproductive substance of flowers, which is transferred from the male to the female portion of the flower or from the male flower to the female flower for the reproduction of species. Nature has provided various methods for this transfer. Amongst these are flying insects, of which bees are the principal. Pollen is the vital substance of the flower in concentrated form, is highly nitrogenous, and contains necessary vitamins. Nature is always prolific, and provides more than is necessary for reproduction purposes. Bees, as they visit flower after flower, carry the pollen from the anthers and fertilise the styles. In doing this they take a toll for their service, and carry some of the surplus pollen away to their hives to make food for their young larvae. When breeding is taking place the nurse bees consume honey and pollen and convert this into chyle food, which is deposited in the larvae cells.

If there is a shortage of pollen, therefore, breeding suffers, and the colonies do not build up, or may dwindle if insufficient bees are not bred to make up for wastage. The importance, therefore, of a pollen substitute has been realised by beekeepers for many years. From experiments that have been made it is evident that the question must be studied scientifically. Recently the Beekeepers' Association of Victoria approached the Commonwealth Committee of Scientific Research with a request that investigation should be made to find a pollen substitute, and this investigation has now been commenced.

The question is being studied in other places, and the following particulars of experiments at the College of Agriculture and Forestry, Brno, Czechoslovakia, will be of interest to beekeepers. As far back as 1871 Fischer propounded the theory that the pharyngeal gland was the source of the larval food. Stephen Soudek at the above College has recently been making microscopical studies of this gland, and his experiments therewith confirm Fischer's conception.

He fed very young bees, which had just emerged from the cells, with different foods and compared the action on the pharyngeal gland. He found that these glands only developed with those bees whose food had contained pollen. In cases where the food only contained honey or sugar, these glands shrank, proving the real importance of pollen. After this he tried many substitutes, amongst which were wheat flour, wheat bran, starch, ground beans, olive seed cake,

linseed cake, peanut cake, ground fish, ground meat, etc. All of these did not bring the pharyngeal gland to development. Only in two cases did the glands become fully turgescient. These were when the young bees were fed with fresh egg albumen stirred into sugar syrup or with dried yeast. He, therefore, assumes that these substances can replace pollen, but states that many further experiments will have to be made before any pronouncement can be made.

He, however, advises beekeepers that as we know of no definite pollen substitute they should, when there is a lack of pollen, feed the bees with the fresh white of an egg stirred into sugar syrup. Pine pollen collected the previous season did not provoke any development of the gland. Bees fed on the yoke of an egg, ground meat and ground fish died in a few days. It is surprising the variety of substances bees will carry into their hive when there is a shortage of pollen. They realise the need for some such substance, and in their extremity have been known to work on wheat shorts fed to cows, fine sawdust, and even coal dust.

The Commonwealth Committee of Scientific Research has commenced investigation, and the results so far show that yeast alone or in admixture with various cheaper protein foods can stimulate the brood food glands to active functioning.

Casein was also found to lead to the development of these glands, and it is suggested that probably a combination of yeast, casein and pollard might prove an effective substitute. Further tests are in progress to determine the cheapest and most effective substitute.

Old pollen that has been stored in the comb for a long time seems to lose its goodness, and bees always prefer the fresh gathered substance.

If there is old hard pollen in the hive, and yet no breeding taking place at the usual time, I would recommend the removal of this pollen by scraping down the comb with a sharp tool almost to the midrib, then pound the pollen—if particles of comb are mixed with it, it will not matter—and stir in with the fresh white of an egg mixed with sugar syrup.

If any method of feeding pollen, or pollen substitute is adopted, care must be taken to feed slowly and to keep up the supply until natural pollen comes in.

11. Feeding.

As a general rule, with proper care, bees do not require to be fed. It should be the aim of all beekeepers to leave plenty of honey in the hive, except at times of heavy honey flow. It is rapidly becoming a custom amongst beekeepers in many countries to leave what is called a food chamber on top of the hives nearly all the year round, containing from 20 to 60 lbs. of honey, according to the season and the district. Beekeepers in Western Australia are recommended to have an extra half depth super for every hive; this should contain from 20 to 30 lbs. honey, and be left on the hive all the year round, empty supers for honey being placed between it and the brood chamber. This gives the bees a feeling of security, and induces them to keep up the population of the hive, and without the fear of starvation.

It is most important that there should be plenty of honey on the hive at the close of winter, as the bees consume a very large amount of honey when brood rearing in the spring.

Dr. E. F. Phillips, in "Beekeeping," estimates that an average strong colony consumes 480 lbs. of honey as follows:—Maintenance 400 lbs., feeding of brood 70 lbs., wax production 10 lbs.

Feeding may be necessary at times, for three different reasons—(1) to provide winter stores, if the food chamber is not full; (2) to stimulate brood rearing;

(3) to provide immediate food for colonies that are short. Feeding should be done inside the hive, for which purpose a variety of feeders may be purchased, the division board feeder being a good one.

An excellent feeder can be made at home by any one handy with tools. This is shown in Fig. 3.

The box is about 6in. x 4in. x 3½in. deep, a division is placed one inch from the end, the bottom only extends to this, thus having an entrance from the bottom, one inch wide. The top of the box consists of a piece of glass which slides in from

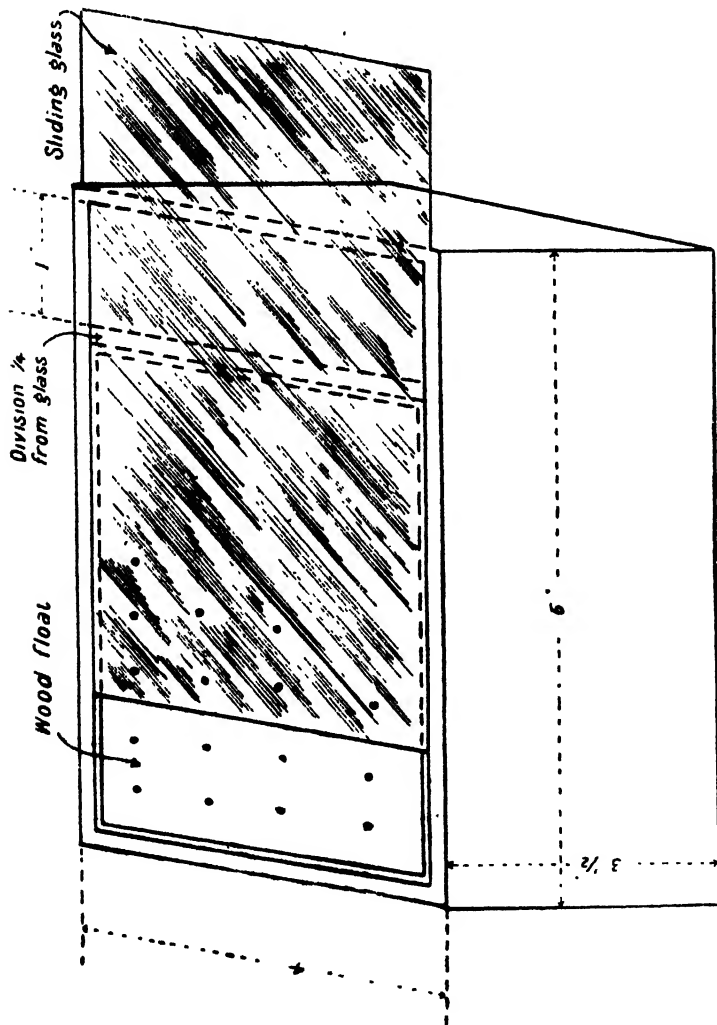


Fig. 3.

the end, a space about ½in. must be left between the top of the wood division and the glass. A piece of thin wood is now cut about ½in. smaller, each way, than the inside of the box, and a number of small holes bored therein. The box is filled with syrup, and a piece of wood acts as a float from which the bees feed, coming up through the inch space, extending over the division on to the float.

The advantages of this feeder are that it can be seen when it is empty, and can be refilled without removing from the hive. The inside may be filled with hot wax, swilled round and emptied out. This will make joints honey tight. If the matter is urgent and the beekeeper has not time to make the above, an effective feeder can be made by punching small holes in the top of a press-top tin, which after filling is inverted on to a plate and placed on top of the frames inside a spare super box; or a quilt from some strong material can be put over the frames, a hole cut in the centre, and the inverted tin placed over the hole. This method has the advantage that, during cold weather, the brood nest is kept warmer than with the plate method. If any colonies are weak, only covering a few frames, entrances should be closed to two or three inches.

In many countries where it is cheap, a syrup for feeding is made from sugar, one advantage of which is that it cannot contain foul brood germs. Honey from an unknown source may; but it is certainly the best food if known to come from hives free of disease.

For Winter Stores or Food for Starving Colonies.

The feed may be made of two parts of honey of good density, or of granulated sugar, dissolved in one part of hot water. This should be fed to the bees as rapidly as possible; if fed through a press-top tin, there should be more holes than when the bees are being fed for stimulating brood rearing. If sugar is used, a little vinegar and salt may be added as referred to under "Transferring."

To stimulate brood rearing the syrup may be made much thinner, using equal parts of water and honey or sugar; or even two parts of water to one of honey or sugar; this should not be fed as rapidly as when feeding for stores.

The best time to feed is in the late afternoon after the work of the apiary has ceased, as the scent of the honey is not then so likely to attract robbers.

It is advisable, if possible, to have a number of sealed combs in store, so that if any colony runs short, one of these combs may be placed in the hive, this is much the best way of feeding. If it is desired to stimulate brood rearing, bruise the cap-pings before placing in the hive.

12. Extracted or Comb Honey.

The small apiarist with a few hives desiring honey for home use, is frequently at a loss how to obtain the honey from the hive and desires to produce comb honey in 1 lb. sections. This is, however, often difficult to produce, and except in good seasons and good localities requires experience. The best plan is to use half depth supers and cut the comb out, replacing this with thin surplus foundation.

For the apiarist with four or more hives an extractor can now be obtained for £3 5s. and the extra amount of honey obtained and labour saved will soon pay for the cost. Larger extractors will of course be required as the number of hives increases.

An article on comb honey production appeared in the *Journal of Agriculture* for September, 1930, but no beginner is advised to attempt to produce comb honey.

13. Wax Moth and Foul-Brood.

The greater and lesser wax moths are often blamed for more than their share of destruction in beehives. Owners of bees often say that moths are responsible for the loss of their bees, but in most cases it is due to inexperience or careless beekeeping. Even beekeepers of long standing make this mistake.

In the first place, colonies must be kept strong with bees of a good pedigree. By this is not meant one body-box full of bees and one or two half empty supers on top. There must be plenty of bees on all combs in districts troubled with moth. Most Italian strains are good battlers against the moth pest, some better than others. Secondly, a large number of home-made hives have not the correct spacing. In many cases the frames are too close to the bottom or sides of the hive. In others they are too close to the cover. In other words, there is not what is called a bee space on all sides of the frame. The bees cannot get through, and start filling the space with propolis. But the moth grub can and does get into these spaces, and the bees, however eager they may be, cannot get at the grub.

In some cases beekeepers use mats of roofing felt, sacking, or other material over the top of the frames; the bees cannot get between the mat and the frame, but the grub can and does. These mats are also a harbour and nesting place for ants. In one case, out of 16 hives with mats on, 15 had ants' nests with thousands of eggs between the mat and the cover.

In normal cases strong colonies should have an entrance of $\frac{1}{2}$ in. deep by the full length of the hive, but if the colony becomes weak the entrance should be contracted by placing a strip of wood along the entrance, reducing this according to strength from the full entrance down to two inches. This will assist the bees to guard the entrance against moths and robber bees.

If, however, the colony becomes very weak it should be united to another colony. Two weak ones united stand a chance of building up to one strong colony, but if left alone will probably succumb to moths or robber bees.

Do not leave hives more than twelve months without cleaning the floor boards; excessive accumulation of cappings or refuse is a harbour for moth grubs. Once a year at least the floor boards and interior of the hives should be scraped and scrubbed with a solution of Izal; one part of Izal to 300 parts of water will be strong enough. Then leave to dry in the sun.

Always remember that prevention is better than cure.

Dealing with the connection of moths with foul brood, some people think that there is no connection between the two, but in many cases moths have been blamed for destruction which has really been due to foul brood. The moths had only come in afterwards. In the meantime robber bees came along and cleaned up the honey, and carried the infection to other hives.

In one recent case the owner found a hive empty, except for moths. He stated he had fumigated this with bisulphide of carbon, and put a swarm into it. On examination nearly all the combs were found to have either infected larvae or dried-up spores of foul brood. On examination of other hives they were found to have foul brood in the early stages. Probably all of these had started from the one empty hive.

Moral—do not blame the moths for all empty hives. The colony may have weakened through a failing or poor queen. The hive may have been so constructed as to assist the moth and hinder the bees, or foul brood may have been the cause of the loss of the bees.

The last cause is a very insidious and dangerous one, as it may cause the spread of this very infectious disease due to mistaken diagnosis.

As foul brood has been found in various parts of the State, it behoves all beekeepers to endeavour to correctly ascertain the cause of weak or empty hives. Any empty hives, with or without moth, should be carefully examined for the spores of foul brood in the brood combs, and if any doubt exists, a sample piece of the comb should be sent to the Department of Agriculture.

There are many diseases of bees, but the most dangerous in Australia are those that attack the brood, and the most infectious of these is American foul brood.

Acarine disease, a disease of adult bees, has destroyed thousands of colonies in European countries, but has not yet been found in Australia. There are therefore very strict regulations on all importations of bees into this country. Western Australia also requires a certificate with all importations of bees, honey and second-hand apparatus, whether from abroad or other parts of the Commonwealth, that these come from a district free of foul brood.

Leaflet No. 152 on Bee Diseases is issued free by the Department of Agriculture and can be had on application.

14. Veils and Opening of Hive.

All beekeepers should provide themselves with a veil and smoker. Gloves should not be necessary. A veil gives confidence, as a sting in the eye may be very unpleasant, as well as inducive of much chaff as to how the other fellow got on. Various patterns of veils can be purchased from dealers. The pattern recommended is the W.A. bee veil, made of mosquito netting with a piece of fly wire about 6 inches by 4 inches let in for free vision and to prevent the netting being blown on to the face. The veil should have a piece of elastic to fit round the hat, and another piece to keep the veil close to the chest. These veils can be obtained from James Goss, Perth.

The best fuel to use in the smoker is pine needles, or failing these sheoak needles, both of these smoulder well and give a cool smoke, much better than old bagging.

When ready to open the hive, give two or three puffs of smoke across the entrance, next lift the lid a little, and puff some smoke across the frames, close the lid for a few seconds, then remove the lid and give a little more smoke across the frames, not down into them, as this would probably drive the bees out at the entrance, and give the beekeeper a rear attack.

A hive tool to loosen and remove the frames is also necessary. These can be purchased or made from an old file. The tag end of the file should be heated and bent over to a right angle, and the point flattened out to about $\frac{1}{2}$ inch. The other end should be ground to a chisel edge; this is useful for scraping and cleaning, while the bent end is used for levering out the frames.

THE GROWING OF SWEET POTATOES.

W. E. COLLINS,

Potato Branch, Department of Agriculture.

Growing to perfection in almost all parts of the State, it is pleasing to note that the sweet potato is finding a place in the home gardens of many people, besides an ever-increasing area in the market gardens. This crop might easily play an important role in the further development of the diversified agricultural industries of the State, more especially since it affords large returns in money from small areas.

The sweet potato belongs to the morning glory family (*Convolvulaceæ*), and is known botanically as *Ipomoea batatas*. It is a drought-resistant plant and produces a crop of roots with very little moisture.

PREPARING THE GROUND.

A sandy loam, in a warm moist climate, is the ideal location in which to grow sweet potatoes, but like almost all crops, they will adapt themselves to many other classes of climate and of land, always, providing they receive proper attention. Given then, a well-drained, moderately fertile, loose sandy soil, maximum yields should result.

Being a deep-rooted crop, they do well on land that has grown lucerne, clover, peas, etc. Where this is not available, the site selected should be well trenched for garden culture, or sub-soiled for field crops, but, in either case, after cultivation and in addition to fertilisation, it will be wise to compress the lower soil, as this will cause the tubers to grow round or cone-shaped, whereas if the lower soil is left loose they will grow ill-shaped and long.

MANURING.

The sweet potato is a great feeder, and being a heavy yielder requires liberal manuring.

As it does best in lighter soils, the organic matter in these should be built up and maintained by previous growths of leguminous crops, or by heavy dressings of stable manure. When this practice has been followed and the ground is rich in organic matter in order to supply the nitrogen required by the crop, this plant food constituent need not be included in the fertiliser applied. In such cases the fertiliser recommended is a mixture of—

Superphosphate—4 parts,

Sulphate of potash—1 part,

applied at the rate of 3 to 5 cwt. per acre.

When the soil is not well supplied with organic matter, and a dressing of stable manure has not been applied, a complete fertiliser is recommended. Potato manure "H" (No. 8), containing nitrogen 4.00, phosphoric acid 12.70, potash 9.00, is a suitable fertiliser. Apply at the rate of 8 to 12 cwt. per acre.

The fertiliser should be sown when the plants are being set out, but owing to the caustic properties of potash and the presence of such in the above mixtures, care should be exercised that the plants do not come into immediate contact with this agent, as it is likely to burn them. After distributing the fertiliser, it should be well incorporated with the soil prior to planting.

METHODS OF PROPAGATION.

Sweet potatoes are propagated either from vine cuttings or from slips, resulting from the sprouting of shoots from the root. Sets of sweet potato seedlings may be procured from most of the local seedsmen, but when it is desired by the grower to raise the plants himself, it is comparatively easy to do so. Medium sized, well-shaped tubers are to be preferred, and are obtainable from any vegetable market. One bushel (56 lbs.) of tubers should produce about 3,000 plants, or enough for about one-third of an acre.

Place them in a bed of well-rotted stable manure, or leaf mould, mixed with equal quantities of soil—sandy soil for preference—in a warm sheltered position, spacing the roots so that they do not touch one another. After the roots are in place they should be covered with from two to three inches of clean sand.

The bed should be kept moderately moist, and with proper management, vines or slips from four to five inches in height will be ready for the transplanting process in about five or six weeks after placing the roots in the bed. When

pulling the slips, place one hand firmly about the soil, so preventing the dislodging of the parent tuber. After removing the first lot of slips, the bed should be well watered; this will induce the tubers to grow a second crop of plants for further transplantings.

In some instances the slips are allowed to grow to the vine stage, and cuttings are then taken from them. If cuttings are selected, leave about three joints on each, with, if possible, a leaf at one end, and when planting leave one leaf and one joint above ground. If desired the cuttings may be looped, and both ends placed in the soil. Whichever system is followed, the cuttings or slips will soon strike roots and start into leaf.

Some growers put in areas of this crop and propagate direct from small tubers, but this practice is not advised. To strike the plants from slips or cuttings is much more favoured. Plant in rows 2 feet 6 inches apart, and, say, 1 foot 6 inches between the plants.

VARIETIES.

There are two general types of sweet potatoes grown in the State—(1) the dry mealy-fleshed varieties of the Jersey group, both yellow and red; and (2) the moist-fleshed sweet potatoes represented by the yam groups.

The dry mealy-fleshed sweet potatoes are the varieties most favoured for culinary purposes, and they keep somewhat better. Unfortunately, but very little attention has been given to improve the strains we have, and much might be done to popularise this very excellent vegetable by the introduction of other varieties.

WHEN TO PLANT.

In many parts of the State it is possible to plant the sweet potato from early September till well on in December, and again it may be sown late in February. In the mild districts where frosts are practically unknown, it may be planted in autumn, and left in the ground throughout the winter.

This latter planting would give excellent terminal cuttings for the September crop. Cuttings should be selected from the plants that carry the largest number of roots of good size and uniform shape.

It will soon become apparent to a grower residing in any locality as to when is the correct season of the year in which to put in this crop, and as any hard and fast rule cannot be laid down for the whole State, or as a matter of fact for any one district, local conditions must govern as to when is the best time to plant.

AFTER TREATMENT.

Keep the soil well worked as long as it is possible to do so, and should the vines appear to be making vigorous growth, lift them occasionally to prevent roots striking into the ground from their outer branches. A few applications of liquid manure may be given, but it should be used moderately. Fowl manure, or blood manure, is a good stimulant for this crop, but if not at hand, nitrate of soda or sulphate of ammonia may be used.

HARVESTING AND STORING.

Sweet potatoes may be dug fit for use in about ninety days after planting out, but as a general rule it is best to wait until the vines are brown and discoloured. On account of its excellent keeping qualities, the crop may be left in the ground for weeks unharvested, without likelihood of its decaying. A number of sweet potato growers in the Osborne Park district make it a practice to harvest at one time, just enough to supply the current needs of the markets. In this they show an appreciation of the quality and flavour of the freshly-dug root, and a knowledge of how to eliminate the problem of storage.

The small gardener would do well to adopt their practice, and never harvest more than the actual quantity of roots needed to supply the household for the day.

Should the ground be required for other crops, dig the roots carefully and allow to dry for a few days in an airy storeroom or shed, after which place separately in boxes or crates and cover with dry sand.

YIELD.

The yield of sweet potatoes depends largely upon the locality and soil in which the crop is grown, the kind and amount of fertiliser used, the culture given, and finally upon the variety itself. A yield of 10 tons per acre can be secured from a crop that is grown under favourable conditions. If estimated on a small garden plot basis, 100 plants, spaced four by two feet apart, should produce at least 150 lbs. of merchantable and 50 lbs. of cull roots.

Again, the yield may be increased by the selection, through several seasons, of individual plants producing heavy crops of desirable and well-shaped roots. The most opportune time to select for improvement is when the crop is being harvested. Vine cuttings should be taken from the plants which contain the largest number of roots of good size and uniform shape.

Many plants should be selected for foundation work, because some of them will fail to transmit their prolific characteristics. Within a period of four or five years the grower will be able to establish a desirable strain of fine quality, which he is entitled to call his own, and to give a special name if its characters are sufficiently distinct.

DISEASES AND PESTS.

It has been found that this crop grows remarkably free from fungus diseases, and if good clean tubers are used to produce cuttings or slips, there is not much trouble from this source. It is, however, wise to spray occasionally with Bordeaux or Burgundy Mixture as a preventive.

Slugs are sometimes troublesome in this crop, but dusting from time to time with slaked lime and tobacco dust will keep them in check. Should cutworms or other insects make an appearance, the usual methods of dealing with them must be resorted to, always exercising great care not to apply arsenical or other poisonous substances to the foliage for several weeks prior to using it as stock food, for which purpose it is excellent.

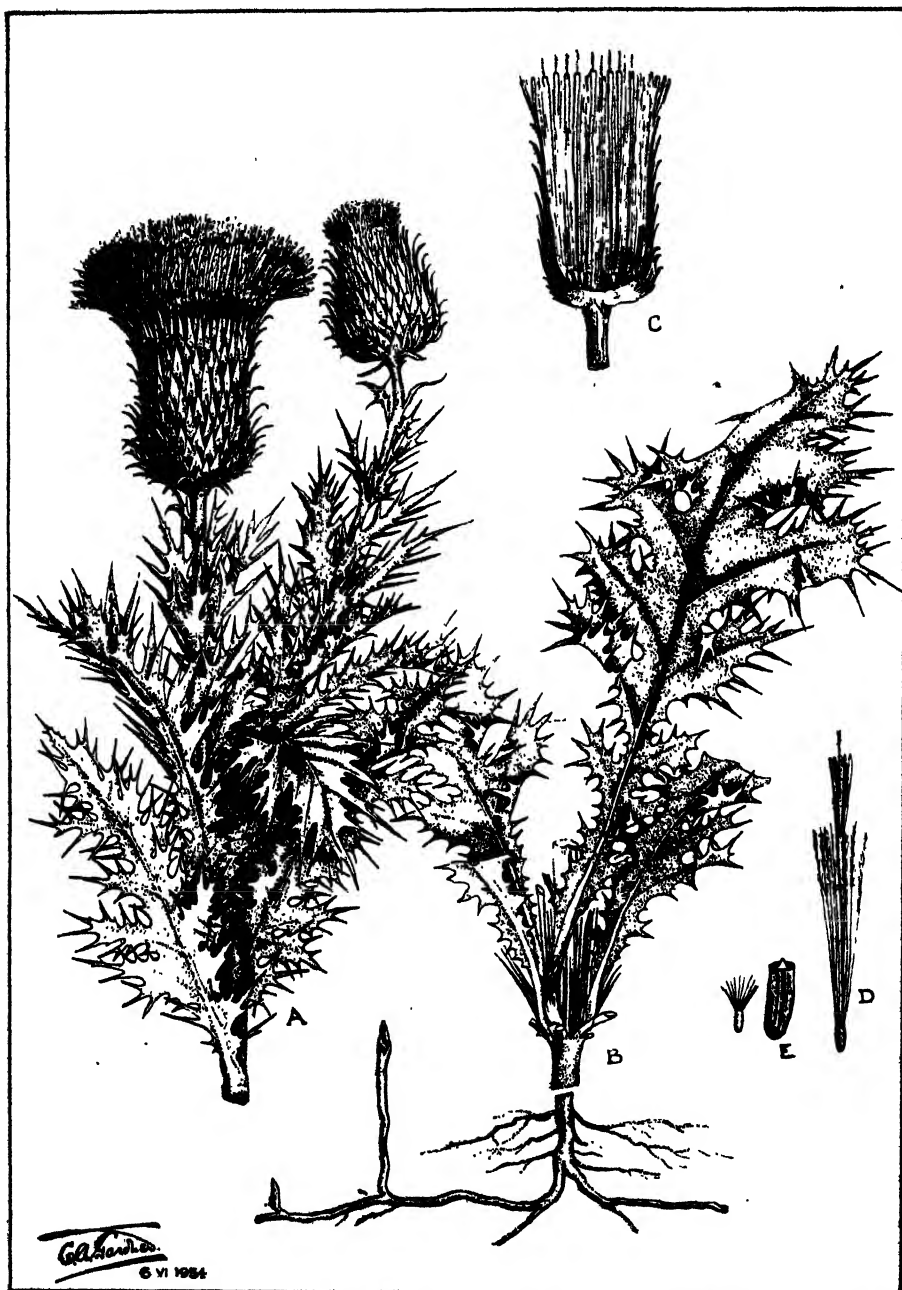
CANADA THISTLE.

(*Cirsium arvense*, (Linn.) Scop.)

A Noxious Weed.

C. A. GARDNER, Government Botanist.

The so-called Canada thistle or Creeping thistle is perhaps the most troublesome of all the plants popularly regarded as "thistles." It is native to Europe and Asia, but is now recorded from most temperate and warm temperate countries, and is everywhere regarded as a serious weed. This is principally because of the difficulties of eradication, for the plant is a perennial, with an objectionable underground "rooting system" consisting of numerous subterranean stems which develop laterally at some depth, producing at intervals shoots which later develop into individual plants.



CANADA THISTLE.

Cirsium arvense (Linn.) Scop.

Geraldton.

1934.

EXPLANATION OF PLATE.

A. Inflorescence and apex of aerial shoot. B. Base of young plant showing basal leaves, roots, and horizontally creeping stems with roots and aerial shoots undeveloped. C. Section through capitulum (flower-head). D. ♂ floret (enlarged). E. Achene (enlarged) with a reduced one at the side.

Geraldton, G. L. Throssell, November, 1933.

Icon. origin.

The species is recorded as a troublesome weed in the South-Eastern parts of South Australia, where it has been present for some years, and it is regarded as a serious weed in Canada, the United States of America and New Zealand. In November, 1933, Mr. G. I. Throssell found a patch of this plant in the Geraldton district. Following its determination it was immediately gazetted as a Noxious Weed for the State of Western Australia. The plants were eradicated by grubbing, and it is hoped that it has been totally eradicated from this district. This is an example of how a weed can be easily controlled when recognised, but it is almost certain that the plant will reappear elsewhere in the future, so that it is important that farmers should be on the watch for this weed, and when discovered should immediately report, so that action can be taken.

The following botanical description, together with the accompanying plate, should assist farmers in recognising the plant. Generally speaking, it can be recognised from the other locally established thistles by the fact that it is perennial, and produces creeping underground rooting stems. It is this latter feature which makes the plant so undesirable, and difficult to control. The flowers are violet-purple in colour. When appearing as isolated plants, these can be removed by grubbing or hand-pulling. At this stage further methods of control are not given, since it is believed that the plant is not at present to be found in Western Australia.

Description of Plant:—A perennial 1-2 feet in height with horizontally creeping, thickened, white or yellowish, branched roots from which, at irregular intervals, erect stems are produced. Perennial with horizontally creeping thickened subterranean branching stems which emit at irregular intervals roots and erect leafy stem-like branches 12-30 inches in height, which are annual or biennial to below the surface of the ground. Stems green, cobwebby, with woolly sparse hairs or hairy with bristly hairs, tall, leafy, and corymbosely branched. Leaves green and almost hairless above, woolly-white or cobwebby underneath, lanceolate to oblanceolate in outline, apex acute and terminating in a spine, deeply lobed and undulate with marginal prickles or spines, the base narrowed and continued down the stem beyond the insertion of the leaf, giving the impression of a spiny stem. Inflorescence cymose, the flower-heads stalked or sessile, dioecious (i.e., the males and females borne on different plants). Involucre of numerous appressed closely imbricated bracts in 12 to 18 series, the outer short, ovate or ovate-lanceolate, unarmed or tipped with short weak spines and cobwebby on the back, the inner successively longer and narrower, glabrous with long pointed tips. Florets reddish-violet or rarely white, fragrant. Pappus white, becoming slightly tawny at maturity, the hairs plumose to below the middle, and united at the base to form a short ring, deciduous. Achenes "seeds" from 2-3.5mm. long by 0.8-1.2mm broad at the thickest point, fusiform in outline, more or less bluntly 4-angled, the apex surrounded by a circular rim within which is a small projection—the base of the style: light brown in colour with a more or less glossy surface. Receptacle covered with hairs 1-1.5cm long, at first white, but coming tawny when the achenes ripen. Flowering season: November to February.

Cirsium from the Greco-Latin *cirsion*, the name of some species of thistle; *arvense*, (Latin) of ploughed fields.

SOME IMPORTANT FUNGAL DISEASES OF GRAPE VINES AND FRUIT TREES IN WESTERN AUSTRALIA AND THEIR CONTROL.

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1. INTRODUCTION.

Orchardists and vigneron in Western Australia are exceedingly fortunate, in that many of the serious diseases and insect pests which annually cause enormous havoc in other parts of the world, including the Eastern States of Australia, have not yet become established in this State.

Thus the Codlin Moth (*Cydia pomonella*) of apples, pears and other pome fruits, is not present here, although some eleven distinct outbreaks have occurred to date. These have all been entirely suppressed, however, as the result of the activities of officers of the Horticultural and Entomological Branches of the Department of Agriculture, acting with the wholehearted co-operation of the growers concerned.*

The black spot or scab disease of the apple (pathogen *Venturia inaequalis*) is also at present unknown here, although two outbreaks occurred in 1930.† In this instance also, with the enthusiastic co-operation of the growers, both outbreaks were suppressed by departmental action, without the destruction of any trees being necessary.

The dreaded downy mildew disease of the grape (pathogen *Plasmopara viticola*) is not yet with us, although serious enough in the Eastern States. Phylloxera (*Phylloxera vastatrix*) and the erinose mite (*Eriophyes vitis*) of the vine, black rot of grapes (pathogen *Guignardia bidwellii*), brown rot of stone fruits (pathogen *Sclerotinia fructicola*), black spot of citrus (pathogen *Phoma citricarpa*), citrus scab (pathogen *Sporotrichum citri*) and pear leaf blister mite (*Eriophyes pyri*), are further examples of troubles, which, serious enough in parts of the Eastern States of the Commonwealth, are unknown here.

* Wickens, Geo. W.:—"Successful Codlin Moth Control in Western Australia," Journal Dept. Agric., W.A., Vol. 5 (2nd series), No. 1, pp. 52-57, March, 1928. (Reprinted as Leaflet No. 248.)

† Pittman, H. A.:—"Black Spot" or "Scab" of Apples and Pears in Western Australia," Journal Dept. Agric., W.A., Vol. 7 (2nd series), No. 2, pp. 241-263, June, 1930. (Reprinted as Bulletin 806.)

Nevertheless the Western Australian fruit grower is not without his share of trouble, from a plant disease point of view, as will become obvious from a perusal of what follows hereinafter.

Some of the most common and important fungal troubles with which the grower in this State has to contend, and the measures which have been found necessary for their prevention or control will now be briefly discussed.

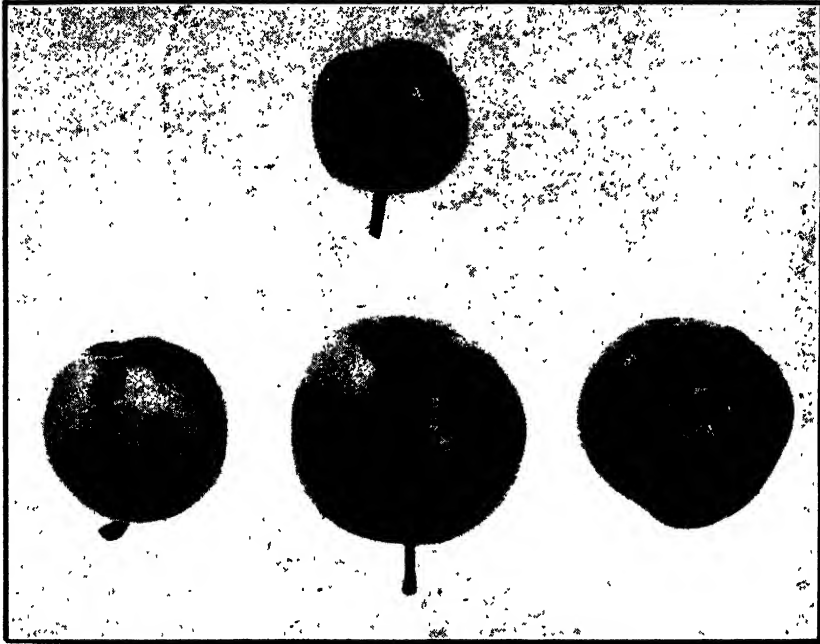


Fig. 1.—“Cleopatra” apples from a 17-acre apple orchard at Manjimup, W.A., which were submitted on 4th April, 1930, to the Department of Agriculture for report as to the disease present. The apples were found to be badly affected with the “Black Spot” or “Scab” disease caused by the fungus *Venturia inaequalis* (*Phusicladium dendriticum*); this being the first unquestionable record of the disease in Western Australia. On the 29th idem, several “Granny Smith” apples similarly affected were submitted from a small orchard at the Porongorups, about 100 miles, as the crow flies, from the first outbreak. In both instances rigorous spraying and other measures were immediately taken by the Department of Agriculture in an attempt to wipe out the disease. These were successful, no infected leaves or fruit being found during the following season on the larger orchard and only two or three apples and a few leaves being found affected during 1930-31 on the smaller orchard. Since that time no infected leaves or fruit have been found in any orchard in Western Australia. The eradication measures included repeated sprayings with strong Bordeaux mixture, immediate destruction of all diseased fruits, the use of a quick-growing cover crop during the autumn and winter to hold the fallen leaves *in situ*, and thorough ploughing and digging under of infected leaves in the early spring before the breaking of the dormancy of the trees, followed by further Bordeaux sprayings until success was achieved.

It is worthy of note that the eradication of the disease was achieved without the destruction of a single tree being necessary. (See Fig. 2 and legend thereunder.)

[Photo. by author.]

2. POWDERY MILDEW OR OIDIUM OF GRAPES.

Taking firstly grapes, as being a crop grown extensively for pleasure and profit in the metropolitan and nearby areas by a very large proportion of the community. There are here two diseases to be considered namely, firstly, powdery mildew or oidium, and, secondly, black spot or anthracnose. The first is by far the most widespread and most commonly met with, as it thrives wherever grapes are grown, irrespective of soil type, provided that the environmental conditions are warm and moderately humid. It is particularly prevalent in “backyard”



Fig. 2.—Upper—Early infection of "Delicious" apple with the "Apple Scab" or "Black Spot" fungus, *Venturia inaequalis* (*Fusicladium dendriticum*). Note the large size of the spot, black margin, and the russeted central area. Natural size.

Lower—Late infection of "Doherty" ("Dougherty") apple showing small size of lesions formed under such circumstances. Natural size.

Since the "Black Spot" or "Scab" disease of apples was discovered in Western Australia in the autumn of 1930, there have been four crops of apples grown and harvested in this State free from this disease. The total areas of bearing and non-productive apple trees in Western Australia during this period have averaged approximately 8,000 and 8,500 acres, respectively, per annum. Experiments conducted by Miss Joan Hearman at Mt. Barker in 1932-33 on the closely related "Black Spot" or "Scab" disease of pears (see this Journal, pages 292-316, June, 1933), showed that the pear disease could be controlled at a minimum cost, for spray materials only, using Bordeaux Mixture, of 3.56 pence per tree. At 100 trees to the acre, and taking this same figure as a conservative estimate of the cost of the spray materials which would be required for an average-sized bearing apple tree, the saving to the apple growers of Western Australia during every year that the "Black Spot" disease of apples is not existent in this State is approximately £12,000 per annum for spray materials alone, even if the non-productive area is entirely excluded. (See Fig. 1 and legend thereunder.)

[Both illustrations after the photos. by E. Bruce Levy in G. H. Cunningham's "Fungous Diseases of Fruit Trees in New Zealand."]

gardens, where the grapes are frequently grown in a too shady place and are often too liberally watered.

Oidium, or powdery mildew, is caused by a fungus known, in the "perfect" stage, as *Uncinula necator*. As commonly met with in this State it occurs in the "imperfect" spore form known as *Oidium Tuckeri*. The fungus causes whitish, dusty-looking patches to appear on the upper and lower surfaces of the leaves, on the young canes and on the berries. The infected areas look somewhat as though finely divided flour had been sprinkled on them. The disease is frequently responsible for very poor setting and scraggly bunches, and for cracking of the berries just before ripening. Infected berries may fail to develop the normal sweetness and flavour characteristic of the uninjured fruit. Berries or canes from which the superficial fungal growth has been rubbed away show a characteristic brownish, russet-like, marking. The fungus grows for the most part externally, absorbing nourishment by root-like structures (*haustoria*) pushed down through the skin (*epidermis*). It is greatly encouraged by shady conditions, by frequent watering of the vines, and especially by the use of a hose or sprinkler on the foliage. Vines grown on the shady side of a house or over a trellis adjoining a dwelling are often very seriously attacked, owing to the insufficient exposure of the fruits and foliage to air circulation and sunlight. The fungus grows best during humid, "muggy," or sultry weather, at temperatures between 75 and 95 degrees Fahrenheit.

CONTROL OF OIDIUM OR POWDERY MILDEW OF GRAPES.

As to its control, the most important point to be borne in mind is that the disease is much easier to prevent than to check after it has been allowed to become well established.

1. Grapes should, wherever possible, be grown in a situation where they will receive the full force of the sunlight during the whole of the day.

2. During the winter time any large unnecessary branches should be removed, so as to allow of free circulation of air and sunlight during the subsequent growth of the vine.

3. During the summer season, if excessively vigorous growth is being made, judicious thinning-out or cutting back of the growth should be carried out, so as to allow of plenty of air and sunlight penetrating into the interior of the vine.

4. Watering should be reduced to a minimum. Although young grape vines need plenty of water in the Perth sand until they become established, older vines will frequently grow quite satisfactorily on the natural rainfall alone.

5. In addition to the above precautions, the shoots should be dusted with sulphur in the spring when about 3 to 4 inches long, and light dustings with "Flowers of Sulphur" should be given from then onwards, in "backyard" gardens, as a precautionary measure, every 10 days or so until the berries commence to ripen or change colour. It is especially important that the bunches be sulphured at blossoming time. This greatly assists in the setting of the fruit, even in the absence of the mildew fungus. In commercial plantings three (3) or more sulphurings may be required as a routine procedure, depending on weather conditions. The first is given just after the shoots develop in the spring, the second at blossoming time, the third a fortnight or so later. Subsequent dustings in commercial plantings generally depend on weather conditions, the growers not giving further dustings unless warm "muggy" conditions develop. In such cases further dustings are immediately given.

The sulphur can be applied by shaking it through a piece of hessian or some similar rather coarse material, or by the use of a special sulphur bellows or dust-gun. Although the sulphur should be applied frequently, it is very important not to apply any great amount to any one place at any one time. When the sulphuring is over, every part of the vine (including the berries) should be just covered with a slight film of sulphur which is barely perceptible to the naked eye. If heavy dustings of sulphur are left on the berries or the leaves, especially during the hottest portion of the year, considerable sulphur scorching may take place during the very hot days.

Where the mildew is already well established, it can be killed by spraying with potassium permanganate (or Condry's crystals) at the rate of 1 lb. of the crystals, 1 lb. of water glass, and one-third pound of baking soda to every 75 gallons of water.* The materials should be thoroughly dissolved in the water and thoroughly mixed before applying to the vine. In applying the spray an effort should be made to thoroughly wet the interior of the vine where the mildew is most abundant. This liquid spray kills only those portions of the fungus that it actually wets, and has little or no effect in preventing further growth of that which is not killed.

(For small quantities the proportions are:—1 oz. permanganate of potash, 1 oz. waterglass, one-third oz. baking soda, and 5 gallons of water.)

To prevent further attack, therefore, the vines should be carefully and thoroughly sulphured as soon after spraying as they are dry, the sulphuring not being delayed more than a day or two after the application of the spray.

The liquid potassium permanganate spray, followed, when dry, by dusting with flowers of sulphur, is usually sufficient to check even a very severe attack of mildew.

3. BLACK SPOT OR ANTHRACNOSE OF GRAPES.

Black Spot of grapes is well established in many vineyards of the coastal plains and foothills. Away from the coast the vineyards are either free or infection is relatively light. It is caused by the fungus called *Gloeosporium ampelophagum*.

Varieties differ considerably in their susceptibility. Black spot is rarely met with in "backyard" grape vines of the metropolitan area, as it appears to dislike sandy soils, but it may cause serious cankering of canes and injuries to leaves and fruit on heavy clay soils in commercial plantings. Sultanas, Malagas, Ohanez (Almeria), Muscats, and Grenache are very liable. Gros Coleman appears to be practically immune.

All green parts of the vine are subject to attack. Dark spots, which grow larger and darker, appear on the berries. The spots are rounded, the centres become sunken and grey in colour, and the margins become reddish or purple. If attacked when very small the berries may become dry and fall; if larger, they become deformed and frequently crack. The flowering stalks are frequently attacked and often become girdled by cankerous spots, causing the flowers or fruits to dry up or fall. On canes the spots become elongated and form dark-coloured pits or cankers with raised edges exposing the wood in the centre. These cankers run lengthwise along the canes and may persist for years. On the leaves the spots are pale grey with dark red or purple borders.

Black Spot is principally a spring disease in this State, developing rapidly so long as the weather is moist or humid. With the usual dry summer weather little

* Jacob, H. E.:—"Powdery Mildew of the Grape and its Control in California," Circular 81, California Agricultural Extension Service, College of Agriculture, University of California, March, 1929.

further infection takes place, but should the wet season continue late, or unseasonable summer rains occur, the disease may continue to spread and make the grower's ordinary methods of control insufficient. Such seasons lead some growers to blame the control measures, not realising that spraying must be adapted to the season and that no hard-and-fast rules as to the number of sprayings required can be laid down.



Fig. 3.—“Black Spot” or “Anthracnose” of grapes, caused by the fungus *Gloeosporium ampelophagum*.

[After W. M. Carne, this Journal, June, 1926.]

CONTROL OF BLACK SPOT OR ANTHRACNOSE OF GRAPES.

The control measures are as follows:—

Firstly, cut out all badly cankered areas and burn all prunings.

Secondly, remove old loose bark wherever possible and burn it.

Thirdly, spray the pruned vines during the *dormant* period with 20-20-40 Bordeaux mixture. This mixture is difficult to handle with the spray pumps, so that some growers have dropped out the lime and use 10 to 20 lbs. of bluestone “straight” to 40 gallons of water. Under our climatic conditions this is quite effective, so that the traditional sulphuric acid and sulphate of iron swab is rarely used nowadays in Western Australia. The majority of growers use from 12 to 15 lbs. of bluestone to 40 gallons of water as a dormant spray, with good results.

Alternatively to recommendation three, if preferred, swab the vines while still dormant with 8 lbs. ($3\frac{1}{2}$ pints approx.) strong commercial sulphuric acid, 35 lbs. sulphate of iron, and 10 gallons of water.

Dissolve the sulphate of iron in hot water or by suspending over night in a piece of bagging in water. Add the acid slowly, while stirring, to prevent spurting.



Fig. 4.—“Black Spot” or “Anthracnose” of grapes, showing effects of attack on young fruit.
[After W. M. Carne, *this Journal*, June, 1926.]

Use a wooden or earthenware vessel. Apply the solution to the vines by means of a small tar brush, a brush made of binder twine on a long handle, or a mop made of woollen rags.

Fourthly, when the buds are bursting, spray with Bordeaux mixture (6.6.40) A second spraying just before blossoming, with Bordeaux (6.6.40), followed by a third after the fruit is set (6.6.40), is usually sufficient. If the spring is dry the second and third sprayings may not be necessary, but if the season continues late, or if summer rains occur, further sprays may be advisable. Later sprayings should be weakened to 50 gallons instead of 40 gallons of water. It is an advantage if a suitable spray spreader such as calcium caseinate is incorporated in the spray on every occasion.

Once the fruit has set, special care should be taken to see that the bunches are well sprayed.

Careful watch should be kept, a spraying following when evidence of the disease spreading is noted. The climatic conditions favouring the disease are (1) humid weather, and (2) rain or heavy dew followed by sunshine*

4. PEACH LEAF CURL.

The disease known as peach leaf curl is caused by the fungus known as *Taphrina deformans*. It occurs wherever peaches and nectarines can be grown successfully, and is a common spring and early summer disease in this State. It also attacks almonds and apricots in some countries, but has not been recorded on these fruits in Western Australia. It is always to be expected in the spring, when preventive measures have not been taken.

Leaf Curl directly affects the leaves, and to a lesser extent the shoots, blossoms and fruits. Evidence of the disease may show soon after the first leaves unfold. The leaves become enlarged, thickened, blistered, and greatly distorted over their affected parts. The whole of a leaf may be affected, but usually only portions of variable size show the characteristic swelling and blistering. The curled portions are at first green, then yellow, whitish, or yellow with a pink tinge, and may become a deep red. A whitish bloom covers the surface. Finally the affected leaves turn brown, die and fall. In this State no further infection usually occurs, new leaves are produced, and by Christmas the trees appear quite normal.

Infection of shoots and fruits is less common than leaf infection. Affected shoots are stunted, curved, and more or less distorted, and the terminal bud usually dies. Flower infection has not been noted here. Where it occurs it causes the blossoms to die and fall. Fruit infection with us occurs on nectarines, and more rarely peaches. Rough, red, irregular blistered areas are developed, giving the appearance of early ripening.

CONTROL OF PEACH LEAF CURL.

Fortunately Leaf Curl is easily controlled. In fact it responds to treatment more readily than any other important disease of fruit trees. One spraying with lime-sulphur (1-10) or Bordeaux mixture (6-4-40) at any time during the dormant period is effective. When San José Scale is present in the orchard, spraying with lime-sulphur (1-7) when the buds begin to swell is necessary. This will also control Leaf Curl without the use of a true dormant spray.

If for any reason preventive spraying is not carried out, and the leaves of peach, nectarine, almond or apricot trees actually become infected, little can be done, in this State, until the next season, with safety, as the foliage and fruits

* A more detailed account of this disease and its control may be found in the article "Black Spot or Anthracnose of the Grape Vine," by W. M. Carne, in this Journal, Vol. 3 (2nd series), No. 2, pp. 178-182, June, 1926. (Reprinted as Leaflet 185.)

of "stone fruits" are very subject to injury by spray mixtures, except at very dilute concentrations, during the summer months. Usually, however, Leaf Curl disappears as the weather becomes hotter and drier towards Christmas and does not re-appear till the following spring.

5. "SHOT HOLE" OF STONE FRUITS.

The "Shot Hole" disease of stone fruits, caused by the fungus *Clasterosporium carpophilum*, is particularly serious each year on early peaches, almonds, plums and apricots which come into growth while the cold wet weather of late winter or early spring still persists. It causes destruction of the blossom buds, irregular cankers on the shoots, dying back and gumming of the twigs, warty, scabby, russetted or fissured areas on the fruits, dwarfing of the fruits, and the familiar holes in the leaves which cause them to appear as though the foliage had been peppered with pellets from a shot gun.

CONTROL OF "SHOT HOLE" OF STONE FRUITS.

For controlling "Shot Hole" (pathogen *Clasterosporium carpophilum*) (and incidentally "Leaf Curl" simultaneously) the best treatment is to delay the dormant spraying until the first buds are just starting to move in the spring ("early pink bud" stage). Then spray very thoroughly with Bordeaux (6-4-40), to every 40 gallons of which has been added $\frac{1}{2}$ lb. of calcium caseinate as a spreader.

If a second spraying is required for "Shot Hole" in the spring, after the early pink bud stage, "lime-sulphur" one part to about 100 parts by volume of water, plus 1 lb. calcium caseinate spray spreader to each 100 gallons, may be used for peaches, almonds or plums, after the fruit is set, *provided the weather is still cool*, or Bordeaux mixture 3-4-50 plus caseinate spreader as above, for apricots.

(In addition to the spraying with 6-4-40 Bordeaux mixture plus spreader at the "early pink bud" stage already referred to, it is an advantage in controlling "Shot Hole" to spray each year just before the leaves normally fall away in the autumn, using Bordeaux mixture of the same strength, 6-4-40.)

Apricots should never be sprayed with lime-sulphur when in leaf, nor should peaches, almonds or plums be sprayed with Bordeaux mixture after the "early pink bud" stage (except just before the dormant period), or considerable dropping of leaves and fruit may result.

6. GREEN ROT OF APRICOTS.

"Green Rot" of newly-formed apricot fruits (pathogen *Sclerotinia sclerotium*) which has been met with in this State on several occasions recently, during very wet springs, may necessitate a further spraying with Bordeaux, 3-4-50, a fortnight or so later than the "fruit set" spray already referred to in the previous section. Apricot fruits affected with this disease develop a soft, brown, collapsed area while they are small, intensely green, and still encircled by the dead flower parts or "shucks."

A satisfactory schedule for the control of "shot hole" and "green rot" on apricots *only*, therefore, is as follows:—

(1) Bordeaux 6-4-40 plus $\frac{1}{2}$ lb. calcium caseinate spreader per every 40 gallons, just before the leaves normally fall away in the autumn.

(2) As No. 1, at the "early pink bud" stage.

(3) Bordeaux 3-4-50 plus $\frac{1}{2}$ lb. calcium caseinate spreader per every 50 gallons, at "fruit set" stage.

(4) As recommendation No. 3, a fortnight later than "fruit set" stage.

7. BROWN ROT OF CITRUS.

There are two forms of "Brown Rot" present in this State on *Citrus spp.*, one of which, the Australian form, due to the fungus *Phytophthora hibernalis*, Carne, occurs mainly during the cold wet weather of the winter, while the other, the Californian form, caused by *Phytophthora (Pythiacystis) citrophthora* (Smith and Smith), Leonian, causes losses during the warm moist weather of the late autumn or spring.

SYMPTOMS OF THE DISEASE—GENERAL CONSIDERATIONS.

The "Californian" Brown Rot is mainly a disease of lemon leaves and fruit. On the other hand, the "Australian" form attacks oranges and mandarins more frequently than lemons.

Both forms occur very much more seriously on very heavy clay soil with a high moisture content than on lighter and better drained soils. Lemon trees growing on very sandy soil frequently show hardly any trace of Brown Rot, whereas similar trees on heavy soil a short distance away in the same orchard, may, at the same period, be almost completely defoliated and have most of the fruit affected.

The symptoms shown by affected fruits and leaves are very much the same no matter by which of the two parasites the disease is caused.

FRUIT SYMPTOMS OF BROWN ROT OF CITRUS.

Affected orange and mandarin fruits develop a dull reddish-brown area, usually on one side, which spreads outwards from the original point of infection in a more or less circular fashion until the whole of the fruit may be involved. The affected areas remain firm to the touch unless secondary organisms have gained entry. Orange, lemon and mandarin fruits affected with Brown Rot are accompanied by a very penetrating and characteristic, not-unpleasant, odour, quite distinct from the odours produced in rotting citrus fruits by such organisms as "Blue Moulds" (*Penicillium spp.*) or the "Sour Rot" fungus (*Oospora citri-aurantii*).

The first-infected fruits and leaves are generally those in contact with, or close to, the soil, but later on infected fruits and leaves may be found at any position in the tree, due to the flicking of spores (fungus-seeds) in drops of moisture, by the movement of the branches, to higher parts of the same or neighbouring trees. In general, however, the disease is progressively less abundant towards the top of the tree.

Affected lemon fruits develop a washed-out, tightly-drawn, pale yellow or almost white colour on the diseased areas, showing in marked contrast to the brighter yellow of the sound skin. A pink or reddish stain may mark the point of infection. The affected areas eventually turn brown. In the rare absence of secondary infection, diseased fruits shrink and dry.

LEAF SYMPTOMS OF BROWN ROT OF CITRUS.

Affected leaves of lemons, oranges and mandarins develop dark-coloured, water-soaked areas, usually at the tips, but sometimes at the edges, or occasionally located in the middle of a leaf. Diseased leaves curl up towards the tips and characteristically fall very readily while still green and healthy-looking over the greater part of their surfaces. The falling of the leaves is one of the most obvious signs of the disease in the early stages. Affected leaves which remain attached to the trees eventually become brown in colour over the diseased areas.

CONTROL OF BROWN ROT IN CITRUS.

1. The winter form of Brown Rot can be very readily prevented in this State by spraying the lower two-thirds of the trees in the autumn, say at the middle to the end of April, before the autumn rains commence, with home-made Bordeaux mixture, 5-5-50. To insure the maximum possible protection, $\frac{1}{2}$ lb. of calcium caseinate spreader should be added to each 50 gallons of spray. The trunks of the trees should be well drenched with the spray as a precautionary measure against "Brown Rot" gummosis, which has been found on the trunks of citrus trees, especially lemons, in several orchards in this State on very heavy moist soils.

2. To guard against infection in the spring by the "Californian" organism, spray the lower two-thirds of the trees with Bordeaux 5-5-50 in late winter or very early spring, say in the first or second week of August.

3. In addition to spraying in the autumn and early spring with Bordeaux mixture, the control of this disease will be facilitated if any excess branches are thinned out, so as to allow plenty of light and air into the centres of the trees to dry up the moisture as rapidly as possible after rain or dew, etc.

4. Any very low-hanging branches which tend to drag on the ground in the wind, or when weighted down by fruit or by rain, should be pruned back so as to leave at least a foot of clear space above the ground all round the tree. This will allow greater freedom of air and light movement, and will facilitate the drying of the leaves and fruit after rain or dews, etc. The Brown Rot fungi (*Phytophthora spp.*) are water-loving organisms, and it is only in the presence of abundance of moisture that they can infect the plant tissues.

5. Drainage, if defective, should be improved.

6. Should the spraying not have been done early enough to prevent the disease establishing itself, spraying should be carried out at the earliest opportunity, i.e., during the earliest fine, quick-drying, weather.

7. All diseased fruits should be gathered up and destroyed by boiling, or burying in a deep hole well away from the site of the orchard and where there will be no danger of flood waters unearthing them and spreading them around the countryside.*

8. STEM-END BROWNING OR ANTHRACNOSE OF NAVEL ORANGES.

For the past half-dozen years or more, a disease known locally as "stem-end browning" has been gradually increasing in seriousness on navel orange fruits grown in this State. The disease does not appear to cause any injury of economic importance to any other variety of citrus fruits. Very rarely a Late Valencia orange has been submitted for examination affected with this disease, and growers report that the same condition has been noticed occasionally on the Jaffa orange, which is only grown here on a very small scale. Mandarins have frequently been submitted showing a rather similar condition, but lemons appear to be quite immune.

The disease is unheard of each year until about the last week in June, when a few specimens of affected navel oranges generally arrive at head office from anxious growers. From then on, all through July, specimens of diseased navel oranges are submitted in large numbers.

The influx of worried growers and the arrival of specimens cease about the beginning of August as dramatically as they commence, and nothing more is heard about the disease until about the last week in June of the following year. The incidence of the disease coincides, therefore, with the period of the year when the navel oranges are fully mature.

* For a more detailed account of "Brown Rot of Citrus," see article of this title, by H. A. Pittman, in this Journal, Vol. IX. (2nd series), No. 2, pp. 286-289, June, 1932. (Reprinted as Leaflet 354.)

SYMPTOMS OF STEM-END BROWNING OR ANTHRACNOSE OF
NAVEL ORANGES.

Affected fruits are almost invariably injured on the stem side of the equatorial region, that is to say, on the "northern hemisphere." The lesions, if very well developed, may, however, extend down below the equatorial zone, but the region near the navel has not been seen to be affected. The lesions take the form of a light to dark brown irregular area which in the early stages is not clearly marked off from the unaffected skin. In the early stages there is no depression of the skin over the injured zone, and the surface discoloration may be quite extensive without any deleterious effect on the flavour or general eating quality of the fruit being noticeable until a considerable period has elapsed. The lesions are very unsightly, however, and greatly affect the market value of the fruit.

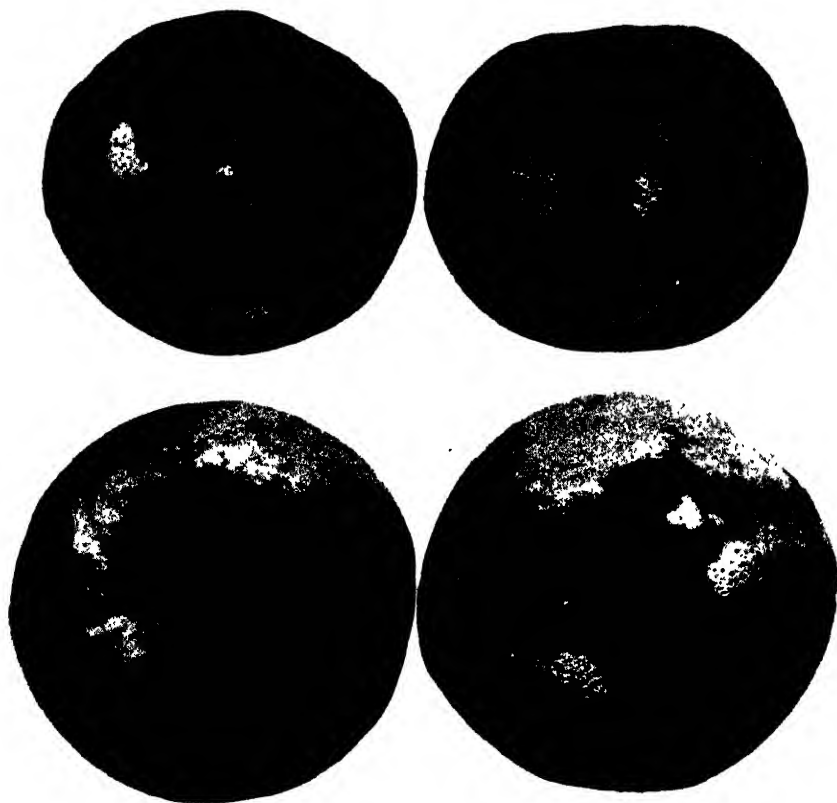


Fig. 5.—"Anthracnose" or "Stem-end Browning" of navel oranges, caused by the fungus *Colletotrichum gloeosporioides*. The top two specimens are resting on their navel ends. The bottom two are so placed that their stem-ends face the observer. The association of the affected areas with the stem-ends of the fruits is thus made clearly manifest. "Tear-staining" is fairly obvious in the case of the two top fruits.

[Photo. by Govt. Printer.]

One of the worst features of the trouble is that fruit may be packed in an apparently sound condition and show a considerable percentage of discoloured fruits when opened up a few days later at the market or in the shop of the retailer.

The diseased areas may make contact with the small circular depressed area where the stalk pulls away from the skin of the fruit, or there may be an irregular band of normally coloured (yellow) tissue around the point of attachment of the

stalk. Frequently the discoloured area touches the stalk depression at one or more points, and then extends asymmetrically for a considerable distance down and around one side of the fruit, without in any way affecting the opposite side.

Sometimes the lesions at one or more points show a "tear-staining" effect; long narrow promontories of diseased tissue extending from the larger diseased areas of the stem-half of the fruit, through the healthy yellow tissues, down towards the navel or styler end. These look as though caustic or corrosive tears had run down over the surface in narrow bands causing permanent stains.

Affected fruits may succumb readily to secondary infection with "blue moulds" (e.g., *Penicillium italicum* or *P. digitatum*), or they may gradually become more or less shrivelled without any sign of rotting of the interior. As they age, the diseased tissues tend to become darker in colour and somewhat depressed, and clearly marked off from the still-healthy yellow skin.

CAUSE OF THE ANTHRACNOSE OR STEM-END BROWNING DISEASE OF NAVEL ORANGES.

This disease is caused by the fungus *Colletotrichum gloeosporioides*, a parasite which is also responsible for a "die-back" and "withertip" condition of miscellaneous citrus trees, such as lemons, oranges, mandarins, etc. The fungus is exceedingly common in this State on citrus leaves and twigs which have died from any cause whatsoever, but it may also be definitely parasitic on leaves and twigs of trees which have been weakened in any way, such as by soil poverty, excess of water or mineral substances in the soil, frost, drought, severe exposure to cold or hot winds and so on.

A number of different strains have been isolated from diseased navel oranges in this State, and a multiplicity of strains have also been found in other parts of the world such as California and Florida, where the disease has been extensively investigated.*

Affected navel oranges are frequently to be found on the trees located just beneath dead twigs, or the dead stubs left behind by the dropping or picking of a previous season's fruits. These dead twigs and stubs, which are very common in most mature citrus trees, produce large numbers of acervuli (minute saucer-shaped fruiting bodies) which spill the fungal seeds (spores) in thousands during wet weather over the leaves or fruits below. It is thus that the "tear-stain" effect on the fruits is produced, as independent infection appears to occur at a number of points along the path covered by a drop of moisture in running down over the fruit.

The brown markings of the disease are most common on windfalls, but they may also be seen developing while the fruit is still adhering to the tree. There is no odour with this disease, and the appearance of the lesions is quite distinct from that of brown rot lesions.

It appears that a considerable proportion of the navel oranges dropping from the trees during July do so on account of infection taking place while the fruit is still on the tree, the discolouration only showing up after the fruits have been on the ground for some days. Infection while still on the tree appears to result in the attachment between the fruit and its "button" becoming so weakened that the weight of the fruit causes it to fall away, leaving the fruit stalk behind.

CONTROL OF ANTHRACNOSE OR STEM-END BROWNING OF NAVEL ORANGES.

The detailed measures necessary for the most satisfactory control of this disease have not yet been experimentally worked out, but the following steps would seem to follow logically from what is known of the etiological relationships (life-history, etc.) of the fungus.

* Fawcett, H. S., and Lee, H. Atherton:—"Citrus Diseases and their Control," McGraw-Hill Co., New York, 1926.

(1) As early as possible in the autumn, say about March in normal years, as much of the dead wood as possible, including small dead twigs, old fruit stubs, etc., should be cut out and burned, so as to destroy as much as possible of the sources of infection. It is important that this be carried out before the advent of heavy autumn rains, so as to prevent millions of fungal seeds (spores) being formed during wet weather on the dead wood.

(2) The trees should be well opened up, to allow of the ready penetration of light and air, by the removal of an odd healthy branch here and there, so that the fruit, twigs, and leaves etc., will dry off, as soon as possible after rain. Moisture and fungal diseases go hand in hand, and the longer the susceptible tissues remain in a wet condition, the greater, other things being equal, will be the losses incurred.

(3) As soon as possible after the heat of summer is more or less definitely past, and, if possible, before the onset of the heavy autumn rains (in other words about the middle to the end of April in normal seasons), *and provided that the trees are not suffering from lack of moisture*, spray the trees at least two-thirds of the way from the bottom upwards with 4-4-40 home-made Bordeaux mixture, plus a suitable spreader, being careful to thoroughly spray the inside area of the tree as well as the peripheral region (which is usually all that is satisfactorily done). If more than two-thirds of the tree is sprayed it will be imperative to add from half to three-quarters of a gallon of prepared white spraying oil per every 40 (forty) gallons of spray, or otherwise there will probably be a serious outbreak of scale insects shortly afterwards, owing to the killing out, by the Bordeaux mixture, of beneficial fungi which parasitise the scales. The oil will prevent this and also act as an excellent spreader to the Bordeaux.

It must be distinctly borne in mind that anthracnose does *not* start from the ground each year, as does Brown Rot of Citrus (see section on Brown Rot earlier in this article), *but the anthracnose fungus is already present in every part of the tree on dead twigs, etc., when the autumn rains commence*. Spraying to control anthracnose must therefore be much more thoroughly and conscientiously carried out than is usually the case for the Brown Rot disease.

(4) A further similar spraying may be necessary at the beginning of June, if the fruits are not well covered with spray at that time.

(5) If the drainage is defective this must be improved. It has been observed that the anthracnose disease is more serious, other things being equal, on properties where water lies about on the surface of the soil for some considerable time after rain.

(6) The trees must be kept in a vigorous condition by the use of adequate and "well balanced" fertilisers, the growth of leguminous (pea family) green manure crops in the winter, good drainage, conscientious cultivation, and timely and adequate irrigation, if necessary, in the summer.

9. BLACK SPOT OF PEARS.

The economic losses due to the "Black Spot" or "Scab" disease of pears—a disease which is widespread in Western Australia—are the result of the growth within the infected tissues of the causal fungus (*Venturia pyrina*) and the eventual production of the summer spores (or "seeds"), in the stage of the life-history known as *Fusicladium pirinum*, in dark velvety masses on the fruit, leaves and young twigs. These spores spread the disease during the summer. They are produced from a mycelium (the thread-like body of the fungus), which lives just below the surface of the leaves, twigs and fruit. When the infected leaves fall in the

autumn this mycelium penetrates the deeper tissues of the leaf and produces numerous globular, open-mouthed fruiting bodies, known as *perithecia*, which mature by the following spring, when they produce a different type of spore called *ascospores*, which infect the developing leaves and fruits with the disease and thus complete the cycle.



Fig. 6.—“Black Spot” or “Scab” of “William’s Bon Chretien” or “Bartlett” pears, caused by the fungus *Venturia pirina* (*Fusicladium pirinum*.)

[Photo. by author.]

CONTROL OF BLACK SPOT OR SCAB OF PEARS.

The disease can be readily controlled by pruning out infected wood during the winter; ploughing the orchard early in the spring so as to *completely* bury all fallen leaves a week or more before the first sign of breaking of the dormancy of the trees; by spraying with 5-4-50 Bordeaux mixture at the bud-bursting stage; and with Bordeaux mixture 3-4-50, at *each* of the following stages, viz., “pre-pink” to “pink,” “petal fall,” and “ten days later than petal fall.” Experiments carried out at Sounness Bros., “Merryup” Orchard, Mt. Barker, by Miss Joan Hearman; in 1932, showed that an additional spraying with 3-4-50 Bordeaux mixture a month later still, improved the control. For example, on Glon Morceaux an improvement resulted from 79 per cent. perfect fruit to 89 per cent. perfect, with 93 per cent. grading either perfect or “plain,” this latter term being used according to the definition of the Commonwealth export regulations. A considerable amount of the remaining 7 per cent. were so lightly affected as to be readily saleable on the local market.*

10. POWDERY MILDEW OF APPLES.

This disease, caused by the fungus *Podosphaera leucotricha*, has been present on apple trees in Western Australia for many years. The Superintendent of Horticulture, Mr. Geo. W. Wickens, can well remember when it was a disease of

* Hearman, Joan:—“Control of ‘Black Spot’ or ‘Scab’ of Pears in Western Australia,” Journal Dept. Agric., W.A., Vol. X. (2nd series), No. 2, pp. 292-316, June, 1932. (Reprinted as Leaflet 380.) A more detailed account of the life-history of the fungus, etc., than given in the text above, will be found in “‘Black Spot’ or ‘Scab’ of Apples and Pears in Western Australia,” by H. A. Pittman, Journal Dept. Agric., W.A., Vol. 7 (2nd series), pp. 241-269, June, 1930. (Reprinted as Bulletin 306.)

minor importance in this State, being confined principally to young Northern Spy stocks in nurseries. At a later period, which he believes was in 1907, he noticed that it was showing up in a number of orchards in the South-West and that it was to be found mainly on Rome Beauty, Five Crown and Northern Spy, but that it was not causing much damage. Since then it has spread little by little until now

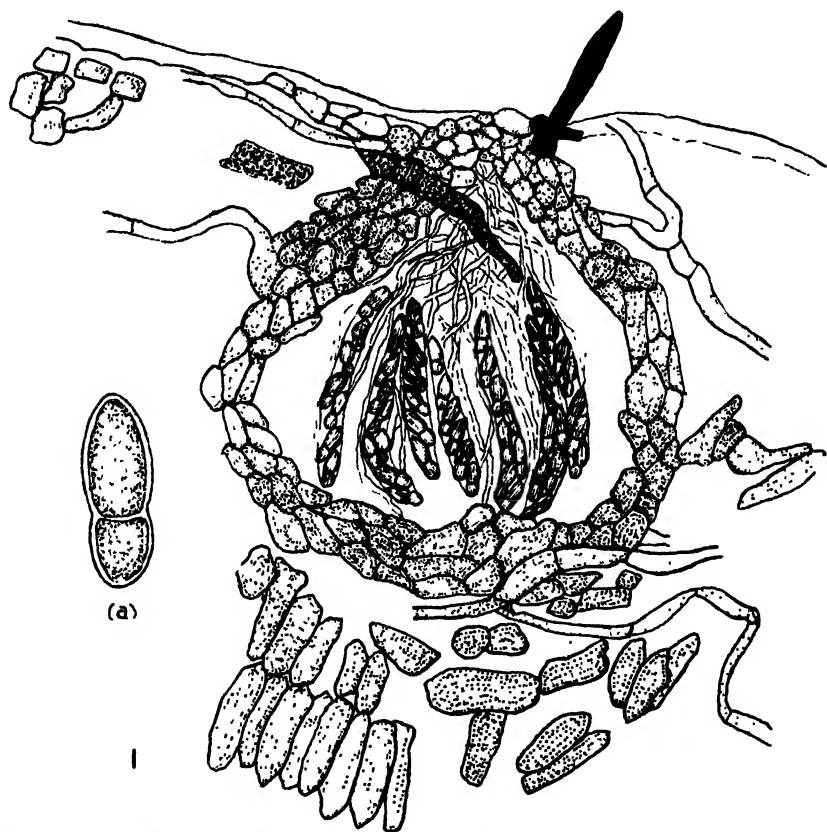


Fig. 7.—Transverse section of an almost mature fruiting body (*perithecium*) of the "black spot" or "scab" fungus of pears, *Venturia pirina*, in an over-wintering pear leaf. Note slipper-shaped 2-celled *ascospores* in their sacks called *asci*. Note also bristles at apex of *perithecium*. Magnified $\times 385$.

[After John Hearman, this Journal, June, 1933.]

there is probably not a single orchard in the State completely free. Some are badly affected, others only in a minor degree, but taken in the aggregate the disease is causing considerable loss to the industry.*

At the present time this is the only fungal disease of apple trees in Western Australia for the control of which spraying or dusting of the foliage and other above-ground parts is required. This may account to some extent, at least, for the rather indifferent way in which its control is attempted.

Being free of the worries of codlin moth and black spot or scab of the apple, as indicated at the beginning of this article, and having of recent years his woolly aphid adequately controlled by the parasite *Aphelinus mali*, which was introduced

* Wickens, Geo. W.:—"Apple Powdery Mildew," Journal Dept. Agric., W.A., Vol. IX (2nd series), No. 3, pp. 392-393, September, 1932. (Reprinted as Leaflet 363.)

to the State by the activities of the Government Entomologist, Mr. L. J. Newman, in 1923, the Western Australian apple grower has not been forced to regard systematic spraying or dusting as a routine and an inescapable part of the process of growing his product, which is the case in probably every other apple-growing country of the world.

No variety is known to be immune in this State, but Cleopatra, Jonathan, Nickajack, and Rome Beauty are amongst the worst, whilst Yates and Dunns are two of the most resistant.

Trees badly attacked by powdery mildew present a very sickly appearance and may become partially or almost completely defoliated. The parasite attacks leaves, shoots, blossom-buds and fruits. On the leaves irregular, white, powdery patches may appear on either upper or lower surfaces or both. The white patches may spread until the whole of the leaf is covered with the superficial growth of the fungus. On the lower side of the leaf the fungus may be difficult to distinguish at times, owing to the very hairy nature of the lower sides of the leaves in some varieties. Infected leaves often roll inwards towards the mid rib and appear longer and narrower than healthy ones.

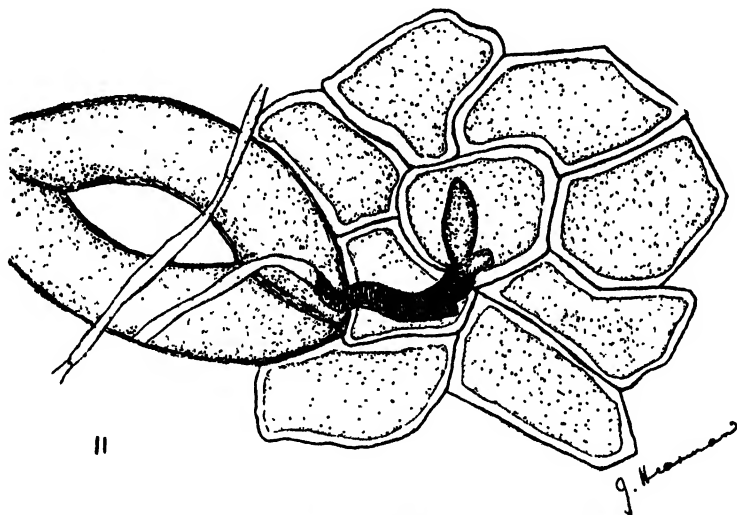


Fig. 8.—Portion of outer layer of cells (*epidermis*) removed from "Beurre Bosc" pear leaf, showing two fungal threads and a *conidiophore* budding off a *conidiospore* (summer spore). Note *stoma* or breathing pore in leaf. Magnified $\times 770$.

[After Joan Hearman, *this Journal*, June, 1933.]

Ultimately they become brownish, more or less extensively dried out, and brittle. Then they crack readily and may eventually fall away from the stem.

Infected shoots have a very conspicuous white appearance, owing to the superficial covering formed by the fungal filaments and *conidiophores* (short stalks bearing fungal seeds or spores in chains, in this fungus). Such diseased shoots may be killed back from the ends for a considerable distance.

Infected blossom buds are smaller than healthy ones and are covered with the white fungal growth so characteristic of this disease. Blossom and leaf buds may be killed out. Dropping of young fruits may be caused and russetting followed by cracking may occur on affected fruits which remain hanging to the tree. The fungus is said to be an "ectoparasite" ("ecto" meaning outside), as it lives for the most part on the outside of its host, absorbing nourishment by means of special

absorbing structures called *haustoria*, which penetrate the internal tissues and function in much the same manner as the roots of ordinary plants. The fungus is carried over the winter in the form of "hibernating mycelium" (overwintering fungal threads) in infected shoots, or possibly also as spores caught in the scales of flower and fruit buds.

When the disease first appears on an orchard it is rarely treated as being of any great consequence, as very few shoots may be attacked and the general health of the trees may not appear to be affected to any serious degree until the disease has been present for a number of years. The effects of the disease are slow, insidious, cumulative and sure. Ultimately, if neglected, very considerable defoliation and dying back of leaders, laterals and fruit spurs may result as a direct effect of attack, or indirectly because of the gradual loss of vigor in the tree.

CONTROL OF POWDERY MILDEW OF APPLES.

1. Early in the winter all twigs, fruit spurs, or terminal buds showing evidence of the presence of the fungus, in the form of the characteristic white discolouration, should be pruned away several inches, if possible, below the lowest obvious sign of infection, before the distinction between affected and healthy shoots becomes obliterated, or obscured, by the weathering processes. All these prunings should be burned.

2. Any infected shoots or buds overlooked during the winter pruning should be cut out and burned as soon as they become obvious by reason of the development of the characteristic whitish covering in the spring. These prunings should also be burned.

If the above two control measures were conscientiously carried out from the time when the disease first made its appearance in an orchard, there would be very little necessity for any other control methods, as the chief source of carry over from season to season appears to be by means of over-wintering fungal threads in the twigs and buds. Unlike most fungi, spores seem to play a comparatively insignificant part in overwintering the powdery mildew of apples.

Some few growers who have had the disease on their properties for many years, and have allowed it to become serious on some of their trees, when advised as above state that if they were to cut out all the infected wood there would be very little of the tree left. They are, therefore, somewhat in the position of a person, who, having taken no effective steps to combat the early manifestations of cancer, eventually finds himself so overridden with the disease that to completely remove the trouble would be to extinguish the vital spark itself. Such a condition of affairs, however, is no argument that the early removal of diseased tissues is not practicable or effective.

3. In addition to the above, spray with Lime-sulphur, 1 to 15, plus $\frac{1}{2}$ lb. calcium caseinate spray spreader to every 50 gallons of spray at the "delayed dormant," "bud-bursting," or "spur-bursting" stage.

4. Spray with Lime-sulphur, 1 to 40 to 50, or Atomic sulphur, 10 lbs. to 80 gallons, at the "pre-pink" to "pink" stage, using calcium caseinate spray spreader at the rate of $\frac{1}{2}$ lb. to every 40 or 50 gallons of spray.

5. Spray with Lime-sulphur, 1 to 50 to 60, or Atomic sulphur, 10 lbs. to 100 gallons at the "petal fall" stage, using calcium caseinate spray spreader at the rate of $\frac{1}{2}$ lb. for every 50 or 60 gallons of spray. Do not spray if the shade temperature is above 75° Fahr.

Any subsequent sprayings (or dustings) with sulphur compounds under the climatic conditions prevailing in Western Australia are decidedly risky, as, should the shade temperature rise to about 90 degrees Fahr. within even a fortnight *after* spraying (or dusting) considerable damage may result to fruit and foliage.

The guiding principle should therefore always be the use of preventive treatment (*i.e.*, recommendations 1 to 5 above) as an annual *routine* procedure, and not a tardy and possibly harmful stable-locking policy when the proper opportunity has long since departed.

6. In instances where the trees have become so badly infected already as to require very extensive pruning to remove all the infected wood, it would probably be the best plan in the long run, to re-work them, by the strap-grafting, or multiple-graft, or multiple-bud method, with those varieties which experience has indicated to be the least affected on the property or in the district concerned.

7. Each season fertilise liberally with sulphate of potash, as this will, if persisted in, increase the resistance of the trees to the powdery mildew, increase the photosynthetic (food manufacturing) efficiency of the foliage, increase the quality of the fruits and the fruitfulness of the trees, give increased resistance to cold and drought, and increase the resistance to lime-sulphur injury during periods of high temperature.

8. It may be an advantage at times to thin out some of the large healthy branches, so as to allow plenty of light and air to circulate freely through the interior of the tree and so dry up the moisture on the leaves, etc., as soon as possible after rains, fogs or dews. Warm muggy weather is favourable to the development of powdery mildew.

9. The drainage, if defective, should be improved, so as to reduce if possible any excessive atmospheric humidity in the immediate neighbourhood of the trees which is so favourable to this disease. Powdery mildew fungi as a group require less moisture to become serious than other fungi, but even here, within limits, the greater the atmospheric humidity, provided it is accompanied by warmth, the more troublesome is the parasite.

11. ONLY HOME-MADE BORDEAUX MIXTURE RECOMMENDED.

In conclusion, wherever Bordeaux mixture has been recommended throughout this article it has been the *home-made variety only* that has been referred to. In all the formulæ given, the first figure means pounds (lbs.) of bluestone, the second figure means pounds (lbs) of freshly-burnt quick-lime, and the final figure means gallons of water. Leaflet No. 314, Second Edition, dealing in detail with the preparation of home-made Bordeaux mixture is obtainable free, on application to the State Department of Agriculture, St. George's Terrace, Perth.*

Citrus trees should not be fumigated with hydrocyanic acid gas, or with any substance which liberates this gas, until at least six months (and preferably longer) have elapsed after the use of Bordeaux Mixture. On the other hand, spraying with Bordeaux Mixture may proceed after the use of substances liberating hydrocyanic acid gas, provided that a fortnight has elapsed after the fumigation before the spray is applied.

* This information may also be found in an article entitled "Bordeaux Mixture—The Most Commonly Used Fungicide," by H. A. Pittman, in this Journal, Vol. IX. (2nd series), No. 4, pp. 542-554, December, 1932.

THE EFFECT ON BODY WEIGHT AND WOOL GROWTH OF FEEDING SULPHUR TO MERINO SHEEP.

E. J. UNDERWOOD,
Animal Nutrition Officer, Department of Agriculture.

INTRODUCTION.

Free sulphur, in the form of brimstone and mixed with treacle, has been used as a mild laxative for man from time immemorial. In animals it is used in large doses as a laxative, and in smaller doses for certain affections of the skin. It is also used externally in various forms and mixtures in the treatment of mange in all species of animals. In very large doses sulphur is a poison, producing strong irritant effects evidenced by colicky pains and powerful purgation.

Free sulphur is unacted upon by the acid gastric juice of the stomach, but in the intestines it is partially converted into alkali sulphides which act as intestinal stimulants, and thus have a laxative effect. Most of the sulphur consumed is excreted in the faeces unchanged, but the small amount of alkali sulphide formed may be excreted in three other ways. It may be oxidised to alkali sulphate and passed out in the urine, or reduced to the gas sulphuretted hydrogen, and excreted both in the breath and through the skin. It is this capacity of sulphur for partial excretion through the skin that makes it valuable in the treatment of certain skin diseases.

Recently, however, mainly through experiments conducted in South Africa by Steyn (1), attention has been turned to the possible value of sulphur not only as a medicine but as a food. It has long been known that wool and hair contain sulphur, an average sample of pure wool containing as much as 3 per cent. This sulphur, however, is not present in simple form, but combined as a complex organic substance known as cystine. It was thought that all the sulphur present in wool had to be supplied in the diet as the highly complex cystine. The work of Jackson and Block (2) has now shown that, in rats at least, the sulphur of the diet may also be effectively supplied in the form of another complex substance known as methionine. Steyn's experiments opened up the interesting and significant possibility that in sheep free sulphur might be acted upon to a certain extent by some of the large number of micro-organisms in the rumen or paunch, and perhaps synthesised by them into the required cystine. Little hope could be held out for this possibility from earlier experiments on small animals (Geiling (3)), but it was known that the rumen contained bacteria with marked synthetic powers. For instance, Bechdel (4) *et al.*, have isolated an organism of the genus *Flavobacterium* from the rumen of the cow capable of synthesising the complex Vitamin "B," which most species of animals require performed in their food supply.

Steyn's experiments were designed to ascertain the amounts of sulphur which could be added without harmful effect to the diet of sheep in the treatment of a form of cyanide poisoning known as "Geilsikte." A fair degree of resistance to cyanide poisoning was found, but in addition considerable increases in live weight and wool growth were reported in the sulphur-fed sheep. The experiments were somewhat unsatisfactory from the point of view of testing the value of sulphur as a food supplement, as Steyn himself realised. The experimental sheep were all 4-tooth or full-mouthed merinos, yet their initial weights ranged from 55 to 116 lbs., and further, the very large weight increases shown by these mature sheep indicated that the ration fed during the experimental period must have been much superior to that obtained by the sheep before the experiment commenced. Nevertheless, the weight increases reported by Steyn were so large and varied so closely with the doses of sulphur given, and the

average wool yields of the sulphur-fed sheep appeared so much higher than the controls (10 to 40 per cent) that an experiment under Western Australian conditions seemed warranted.

Since the publication of the South African work, experiments have been conducted by Seddon (5) in New South Wales, and Peirce (6) in South Australia. Seddon used two groups of seven merino hoggets even in body weight, size and wool quality. These two groups were run together for two years on pasture, one group receiving 10 grms. sulphur per sheep three times weekly. The sulphur had no effect on either body weight or wool yield. In the experiment of Peirce, two groups of five mature sheep, selected for evenness of fleece weights and wool quality, were used. Both groups were given an artificial diet just above a maintenance ration but containing insufficient cystine, the sulphur containing constituent of wool, for normal wool growth. The addition of two grammes of sulphur per day to each sheep in one of the groups over a period of seven months gave no increase in wool growth or effect on wool quality.

DETAILS OF EXPERIMENT.

As information as to the effect of sulphur on growth as well as on wool yield was required, it was decided to use young merino wethers for the experiment. Accordingly, twenty weaners (aged 6-8 months) and twenty hoggets (aged 18-20 months) were selected from the flock at the Avondale State Farm, Beverley, weighed and divided into two even groups of twenty, each group containing ten weaners and ten hoggets. The range of live weights in each group at the commencement of the experiment were very similar. The range was as follows:—*Group I.—Controls.*

Weaners—59-74 lbs. (average 66.9); hoggets—82-103 lbs. (average 94.9).
Group II.—Sulphur-fed Sheep.

Weaners—55-74 lbs. (average 66.2); hoggets—83-102 lbs. (average 94.3).

Throughout the experiment all the sheep were run together on ordinary pasture and stubble typical of the grazing of the district, and at rather less than normal rate of stocking. The sheep were brought into near-by yards three times weekly with the minimum of handling possible, and the sheep of Group II. given 5 grammes of sulphur each on each of the three days, making a weekly dose of 15 grammes (approximately $\frac{1}{2}$ ounce) per sheep. The sulphur was given to each sheep through a small dry funnel so as to make certain that the correct amount was consumed by each animal. In addition, all sheep were weighed at monthly intervals. The experiment was carried out for a period of nearly ten months, commencing on 8th December, 1932, two months after shearing, and finishing on 26th September, 1933, when the feeding of sulphur was discontinued, the sheep shorn, and the wool yields of the two groups measured.

The season was fairly typical, except that the autumn rains were later in coming than usual. In consequence the dry food conditions of March and April were severe, and the green feed of June exceedingly scanty. From July to September the pasture available to the experimental sheep was ample and of fair quality, consisting principally of Cape Weed and Burr Clover.

RESULTS OF EXPERIMENT.

(a) *Body Weights.*

The mean monthly live-weights and range of weights of the weaners and the hoggets in each group are given in Table 1. The terms, "weaners" and "hoggets," will be used throughout, though at the end of the experimental period these animals have become hoggets and 4-tooths, respectively.

TABLE 1.—MEAN LIVE WEIGHTS OF SHEEP, IN LBS.

	8-12-32.	9-1-33.	9-2-33.	9-3-33.	10 4 33	8-5-33.	5-6-33.	4-7-33.	3-8-33.	8-9-33.	24 9 33. (Shown Weights).
Group 1 (Control)—											
Weaners ...	66.9	65.2	67.9	69.0	72.3	72.4	77.1	81.0	78.9	85.4	82.7
Range ...	(59-74)	(59-73)	(59-76)	(60-78)	(84.77)	(84-77)	(88.84)	(70-90)	(70.84)	(72-97)	(73-92)
Hoggets ...	94.9	89.8	92.4	89.6	92.7	91.8	96.1	99.5	95.5	101.9	99.3
Range ...	(82-103)	(76-97)	(79-107)	(78-100)	(79-102)	(78.100)	(80.107)	(86-109)	(80-104)	(85-110)	(84-107)
Mean of Group 1 ...	80.9	77.5	80.1	79.3	82.5	82.1	86.6	90.3	87.2	93.7	91.0
Group 2 (Sulphur)—											
Weaners ...	66.2	61.9	63.5	64.3	69.8	69.5	74.6	78.6	75.7	81.6	82.2
Range ...	(55-74)	(45-76)	(46-80)	(48-81)	(50-76)	(52-76)	(59-87)	(62-93)	(59-90)	(66-99)	(72.96)
Hoggets ...	94.3	88.3	91.1	89.5	91.7	90.3	95.4	100.3	97.2	103.7	100.0
Range ...	(83-102)	(80-99)	(84-105)	(78-103)	(82.104)	(79-100)	(87-106)	(97-109)	(88-108)	(96-115)	(90-114)
Mean of Group 2 ...	80.3	75.1	77.3	76.9	80.7	79.9	85.0	89.5	86.5	92.7	91.1

During the first month of the experiment there is a fall in mean live-weight in each group, the drop being slightly greater in the sulphur-fed sheep. However, the fall in weight of the hoggets of the Control group in the first month, *i.e.*, 6 lbs., is almost identical with the fall in weight of both weaners and hoggets of the sulphur group. During the following four months there is little fluctuation in the mean live-weights of the two groups, a small gain in weight of the weaners in each group being counterbalanced by a small loss in the weights of the hoggets. The 2 lbs. difference in favour of the control group noticeable in the first month is still apparent at this time, but it is not statistically significant, and cannot be attributed to any deleterious effect of the sulphur feeding. During these months it is apparent from the weights that the dry oaten stubble grazing has provided less than a maintenance ration for the hoggets and a little more than a maintenance ration for the weaners. Under such nutritive conditions the feeding of sulphur has had no beneficial effect.

At the June weighing both groups show an evenly distributed increase in live-weight of about 5 lbs., followed by a further general increase of about 4 lbs. in the succeeding month. Late July was exceedingly wet and cold, and there was an appreciable fall in live-weights in both groups at the early August weighing. This was followed by a good general increase during August and September, the weaners at this time being about 4 lbs. heavier, and the hoggets nearly 2 lbs. lighter in the control than in the sulphur-fed group. In each case this small difference is shown by statistical means to be due to chance alone, and not to the influence of the treatment given.

The shorn weights obtained on 26th September are of interest in showing the effect of the treatment on body growth as distinct from wool growth. Throughout the experiment the weaners gained an average of almost exactly 16 lbs. in body weight in each group, and the hoggets $4\frac{1}{2}$ lbs. in the control group and $5\frac{1}{2}$ lbs. in the sulphur group. These figures are remarkably similar for the two groups, and show quite clearly that the sulphur feeding has had no effect on the body-weight.

(h) *Fleece Weights.*

The mean fleece weights and range of fleece weights of the "weaners" and "hoggets" of each group are given in Table II. It must again be pointed out that at the time of shearing the sheep called weaners have grown into hoggets, and those described as hoggets have become 4-tooths.

TABLE 2.—MEAN FLEECE WEIGHTS, in lbs..

Group 1—Controls ...	...	Weaners	10.4	Range (8.5—13.2)
		Hoggets	11.8	Range (11.2—13.8)
Group 2—Sulphur ...	...	Weaners	10.3	Range (8.2—12.5)
		Hoggets	11.8	Range (10.2—14.0)

The figures of Table II. show that though the ranges of fleece weights are large in each group they are very similar in magnitude, and the mean fleece weights of the two groups, both with the "weaners" and with the "hoggets" are almost identical. It is obvious that the sulphur has had no effect on wool growth.

Samples of each fleece drawn from the shoulder were taken and shown to Mr. H. MacCallum, Sheep and Wool Expert of the Department of Agriculture. He reported no apparent differences in the two groups, except that the fleeces of the sulphur group appeared slightly heavier in condition. The qualities ranged from 56-70's, with a preponderance of 64's in each group. The wool was well

grown and appeared to be well nourished, though a number of tender fleeces were present in both groups. There was just as much tendency towards tenderness in the wool of the sulphur group as in the controls, both reflecting the poor nutritive conditions of March and April. As far as could be judged, therefore, from the limited data available, the sulphur had had no effect on wool quality.

SUMMARY.

A brief general survey of information concerning the effect of feeding sulphur to animals is given.

An experiment is described in which 40 merino wethers were divided into two even groups of 20, each containing 10 weaners and 10 hoggets, and run together on normal pasture and stubble for a period of 10 months. One group received five grammes free sulphur per sheep three times weekly throughout.

From the fleece weights and monthly weighings of the sheep, it was concluded that the feeding of sulphur under these conditions had no effect on body-weight or wool growth.

References.

- (1) Steyn, D. G., 17th and 18th reports Dir. Vet. Serv. and Animal Ind., Sth. Africa (1931 and 1932).
- (2) Jackson & Block, Jn. Biol. Chem. 98, 465 (1932).
- (3) Geiling, E. M., Jn. Biol. Chem. 31, 173 (1917).
- (4) Bechdel, Honeywell, Dutcher and Knutsen, Jn. Biol. Chem. 80, 231 (1928).
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SOME NEW IDEAS ON NITROGEN NUTRITION OF PLANTS.

W. M. NUNN, B.Sc. (Ag.), Muresk Agricultural College.

The belief that inorganic nitrogen compounds—principally ammonia and nitrates—are the sole sources of nitrogen for plants, and that organic nitrogen must first be decomposed before it can be assimilated, has stood since the investigations of Leibig and Boussingault. Opinions have varied as to which of the two forms is most favourable, but the possibility of organic nitrogen being directly absorbed, has been generally rejected. Recent research by A. I. Virtanen of the Foundation for Chemical Research, Finland, has thrown new and definite light on the question, and has made it evident that the accepted opinion is in need of revision.

Experiments carried out with legumes growing in sterilised quartz sand showed that the plants grew more vigorously when inoculated with their specific nodule bacteria, but without nitrogen fertiliser, than when not inoculated but provided instead with an adequate supply of nitrogen in the form of ammonia or nitrates. Moreover, organic nitrogen compounds were found to be present in the sand, and must have been diffused from the nodules since no other nitrifying organisms were present. Thus the legumes grew better when drawing their nitrogen from the organic supply in the nodules than when dependent on an inorganic supply, and at the same time much organic nitrogen was allowed to diffuse into the sand.

When different cereals were grown together with the legumes, it was found that they could utilise the organic nitrogen diffused as above, one pea plant supplying enough nitrogen for itself and two oat plants—and all in an organic form. The growth of the oat plant was markedly impaired when the ratio of oats to peas was increased. Curiously enough, the growth of the pea was also impaired and obviously through a deficiency of nitrogen. This fact, it is suggested, indicates that the legumes obtain only part of their nitrogen directly from the nodules, while the other part consists of nitrogen compounds diffused into the soil and again absorbed by the roots.

Special experiments were carried out to ascertain the chemical nature of the nitrogen compounds which diffuse from the nodules. All were conducted under sterile conditions, so that no other micro-organisms could be present to decompose the compounds formed. The results showed that the diffused compounds contained neither ammonia nor nitrate but consisted solely of organic nitrogen mainly in the form of amino-acids.

Having ascertained that the nitrogen diffused was all in organic form, further extensive experiments were carried out to verify the above suggestion that non-legumes could utilise it as such. Peas and barley were grown together under sterile conditions. The barley was entirely dependent for its nitrogen on the organic compounds diffused from the nodules of the legume, and it thrived particularly well. These conclusive experiments prove that non-legumes can utilise the organic nitrogen diffused from the nodules of leguminous plants. It is evident then, that non-legumes growing together with legumes in nature could actually use such compounds without the latter being necessarily first broken down to ammonia or nitrates. This is in accord with the oft observed circumstance, that the inclusion of legumes with a cereal crop will, despite the extra competition, have no detrimental effect upon the cereal and possibly even enhance its growth.

It has also been shown that plants growing on soils rich in organic nitrogen, where decomposition takes place slowly, utilise organic nitrogen on a large scale. Both barley and peas grew in sterile cultures with soluble organic nitrogen substances as their only source of nitrogen. Similar experiments showed that the soluble organic nitrogen of stable manure can also be utilised by plants without preliminary bacterial breakdown.

Thus it seems conclusive that the old theory of nitrogen nutrition of plants, prevailing since Leibig and Boussingault, must be modified. The higher plants can readily utilise certain organic nitrogen compounds found in soils without these being first necessarily broken down by micro-organisms with the production of ammonia. The exact nature of, and the manner in which the plant utilises, the absorbed organic nitrogen compounds is not yet definite, but Virtanen suggests that enzymes of the plant cells might possibly split off ammonia from the organic nitrogen already in the root system, the ammonia being then used for the albumen synthesis of the plant. Such enzymes are actually found in plant material—the enzyme “Urease” which splits off ammonia from urea, and “Asparaginase” which splits the amide group from asparagine. It might also be possible that certain amino-acids are used for albumen synthesis without preliminary decomposition. It has been proved that with the organic nitrogen, plants also absorb certain carbon chain compounds which is not the case with nitrates or ammonium salts. The possibility that these carbon compounds might also be of importance to the life of the plant should not be overlooked, and time may show that much of our theory of plant nutrition is in need of revision.

MAIZE VARIETY TRIALS 1933-34.

H. G. ELLIOTT, Agricultural Advisor, Dairy Branch.

(Continued from pages 335-338, June, 1934 issue.)

The results obtained from the trials not completed at the time of publication of the previous issue of the "Journal" are as follow:—

		Hickory King.	Silvermine.	Welln-grove.	Fitzroy.	Small Leaming.
A. Thompson, Denmark	Tons per acre .. Percentage Yield	27 100	28 104	21 78	30 111	27 100
Barton Langridge, Donnybrook	Tons per acre .. Percentage Yield	28 09 100		10 90 71	31 40 112	22 90 82

The average production of green material for Series 1 is given in the following table:—

Variety.	Tons per Acre.	Percentage Yield.	No. of Trials.
Hickory King	16.75	100	7
Silvermine	14.81	88	6
Welln-grove	14.45	86	7
Fitzroy	18.21	109	7
Small Leaming	16.86	101	7

SERIES 2.

		Hickory King	Early White Dawn.	Early Morn.	Funks Early Yellow Dent.	90 Day (Flint).
A. S. Hilditch, Northcliffe	Tons per acre Percentage Yield	17.39 100	13.34 76 7	16.90 98	21 08 121	17 48 101
B. Langridge, Donnybrook	Tons per acre Percentage Yield	28 09 100	.. .	17 81 62	30 13 107	.. .

The average production of green material and the percentage yield for series 2 are given in the following table:—

Variety.	Tons per Acre.	Percentage Yield.	No. of Trials.
Hickory King	15.87	100	6
Early White Dawn	12.03	76	5
Early Morn	13.21	83	6
Funks Early Yellow Dent	16.18	102	6
90 Day (Flint)	12.20	76	5

The average for all trials is as follows:—

Variety.	Green Material— Tons per Acre.	Percentage Yield.	No. of Trials.
Hickory King	16.308	100	13
Fitzroy	18.212	112	7
Small Leaming	16.862	103	7
Funks Early Yellow Dent	16.182	99	6
Silvermine	14.808	91	6
Welln-grove	14.454	90	7
Early Morn	13.212	81	6
90 Day (Flint)	12.203	75	5
Early White Dawn	12.029	74	5

Seed.

Of the 13 trials conducted at various centres, only four matured seed and gave the following yields:—

Variety.	Bushels per Acre.	Percentage Yield.	No. of Trials.
Hickory King	43.0	100	4
Funks Early Yellow Dent ...	41.6	97	2
Small Leaming	41.4	96	2
Early White Dawn	36.1	84	2
Silvermine	34.3	80	2
Wellingrove	31.4	73	1
90 Day (Flint)	30.8	72	2
Fitzroy	30.4	71	2
Early Morn	29.8	69	2

The results of the experiment for the first year indicate that at present no departure from the stand variety "Hickory King" can be recommended for either seed or green material.

These trials are being conducted again this season.

HORTICULTURAL NOTES.

GEO. W. WICKENS, Superintendent of Horticulture.

EXPORT.

The quantity of fruit exported from Western Australia during the year ended 30th June, 1934, showed an increase of a little more than 102,000 cases when compared with shipments for year ended 30th June, 1933. In season 1932-33 the apple crop in the Mount Barker—Albany district—was badly affected by a visitation of thrips in plague form during blossoming time, and in consequence the quantity available for export was much below normal. In season 1933-34 apple trees cropped heavily throughout the same district; in fact, they produced sufficient to make up for a crop somewhat below average in other parts of the State, and the number of cases of apples exported increased by 114,182, from 504,052 to 618,234. The increase would have been greater if it had not been for the reduction imposed by regulation in the number of varieties permitted to be shipped, and the elimination of "plain" grade.

The pear crop was lighter in all districts, and the quantity exported this year showed a decrease of 13,198 cases, from 46,986 in 1933 to 33,788 in 1934.

The crop of table grapes varies less from year to year in Western Australia than any other fruit produced in the State, and the quantity exported annually experiences only slight changes. The difference between shipments in 1933 and 1934 was 1,622 cases: 44,685 cases being sent away in 1933 and 46,307 in 1934.

The only other kind of fruit than the three mentioned above that is exported from Western Australia in commercial quantities is the orange, and, unfortunately, owing to the difficulty of finding a payable overseas market, shipments are very moderate, ranging from 3,000 to 7,000 cases annually; last year 4,367, this year 3,860 cases.

Though complaints are often heard to the effect that sufficient enterprise is not shown in seeking overseas markets, the list of places to which Western Australian fruit is exported goes to show that the shipping agents who handle this phase of the industry do not go to sleep on the job.

Full particulars showing destinations and quantities are as follow:—

Destination.	Apples.	Grapes.	Pears.	Oranges.	Lemons.	Quinces.	Peaches.	Plums.	Nectarines.	Passion Fruit.	Tomatoes.	Total.
London	cases, 208,215	cases, 10,280	cases, 20,346	cases, 1,258	cases, 146	cases, 32	cases, 5	cases, 22½	cases, .	cases, 1	cases, .	cases, 249,285½
Liverpool	cases, 36,471
..	cases, 10,075
..	cases, 1,012
..	cases, 37,214
..	cases, 192,004
..	cases, 15,346
..	cases, 195,082½
..	cases, 67,037½
..	cases, 1,830
..	cases, 21,610
..	cases, 1,419
..	cases, 20,739½
..	cases, 395
..	cases, 100
..	cases, 223
..	cases, 114
..	cases, 229
..	cases, 197
..	cases, 30,613½
..	cases, 632½
..	cases, 2,412
..	cases, 7,517
..	cases, 2,155½
..	cases, 18½
..	cases, 68½
..	cases, 8
..	cases, 214
..	cases, 76
..	cases, 6½
..	cases, 1
..	cases, 30
Totals..	618,234½	16,307	33,798½	3,840	211	32	76	248½	6½	1	30	702,795½

ACREAGE AND PRODUCTION.

In season 1932-33 (latest figures available) the total area under orchards in Western Australia amounted to 20,124 acres, and in these days, when advice is being so freely tendered not only to cease increasing the area under fruit, but to take, and make, opportunities for reducing same, it is interesting to turn up old records and note that season 1915-16 was the peak year for orchards in Western Australia when the total amounted to 21,805 acres; from then a steady and regular decline took place until in season 1925-26 the area had been reduced to 18,358 acres—a reduction approximately of 3,500 acres. From that year a slow increase has taken place so that in 1932-33 the total area amounted to 20,124 acres, but was still less by 1,681 acres than in the peak year of 1915-16. It may be stated that fruit trees of non-bearing age comprised approximately 39 per cent. of the total area in 1915-16, whereas in 1932-33 they were approximately only 26 per cent., but consideration must also be given to the fact that in 1916 the population of Western Australia amounted to 308,806 persons, and in 1934 had increased to 442,521, or an addition in population of 43 per cent. In the years quoted the area under apple trees has varied more than that under any other kinds of fruit trees.

Particulars of variations in area of the principal fruits are as follow:—

	Season 1915-16.	Season 1925-26.	Season 1932-33.
	acres.	acres.	acres.
Oranges	2,861	3,047	2,807
Mandarins	267	184	166
Lemons	372	572	506
Pears	1,568	1,191	1,033
Apricots	713	717	678
Peaches	1,420	871	779
Nectarines	280	208	199
Plums	1,024	911	969
Apples	11,894	9,751	11,958

From the figures quoted it will be seen that apples and lemons are the only ones of the principal orchard fruits grown in Western Australia that had a greater area in 1932-33 than in 1915-16.

Full particulars of acreage and production of all fruits, including vineyards, for year ended 30th June, 1933, are as follow:—

FRUIT PRODUCTION AND AVERAGE FOR SEASON, 1932-33.

Orchards.

Kinds of Fruit.	Area.			Yield.
	Unproductive.	Productive.	Total.	
	acres.	acres.	acres.	bushels.
Almonds	47	154	201	3,038
Apricots	108	570	678	55,437
Apples	3,868	8,090	11,958	804,048
Bananas and Plantains	8	21	29	412
Figs	53	292	345	37,326
Lemons	54	452	506	58,067
Mandarins	24	142	166	15,324
Oranges	415	2,392	2,807	251,272
Other Citrus	14	21	35	2,180
Nectarines	53	146	199	14,471
Peaches	165	614	779	56,479
Pears	109	924	1,033	121,574
Plums	243	726	969	72,696
Quinces	14	78	92	8,807
Small Fruits ... ..	...	156	156	...
All other Fruits	38	133	171	...
Total	5,213	14,911	20,124	1,500,931

Vineyards.

Vines.	Area.			Yield.
	Unproductive.	Productive.	Total.	
	acres.	acres.	acres.	cwts.
Table Grapes ... ..	...	962	962	53,579
Wine Grapes ... ..	...	1,513	1,513	44,685
Drying Grapes ... ..	...	2,480	2,480	171,267
Not Bearing Vines ...	556	...	556	...
Total	556	4,955	5,511	269,531

TREES AND PLANTS BROUGHT INTO WESTERN AUSTRALIA FROM THE EASTERN STATES.

Inspections made of trees and plants entering the ports of Fremantle and Albany show that, in addition to those grown by local nurserymen, sufficient fruit trees were imported during the year ended 30th June, 1934, to increase the orchard area in Western Australia by 1,000 acres, allowing 100 trees per acre.

Full details are as follow:—

"PLANT DISEASES ACT, 1914."

Return of Fruit Trees and Plants Inspected at the Ports of Fremantle and Albany for Year ended 30th June, 1934.

Kind of Trees.	Fremantle.	Albany.	Total.
Apple	18,284	23,713	41,997
Apricot	2,718	588	3,306
Almond	2,344	104	2,448
Cherry	855	56	911
Fig	536	40	576
Lemon	5,975	55	6,030
Loquat	995	24	1,019
Mulberry	451	14	465
Nectarine	2,125	30	2,155
Orange	24,393	32	24,425
Peach	7,149	234	7,383
Persimmon	219	...	219
Pear	1,508	889	2,397
Plum	7,641	566	8,207
Quince	242	25	267
Other Nut	508	72	580
Ornamentals	26,365	225	26,590
Currant	507	125	632
Gooseberry	653	80	733
Loganberry	106	...	106
Raspberry	565	130	695
Bulbs and Roots	242,878	200	243,078
Strawberry	1,100	750	1,850
Apple Stocks	38,575	...	38,575
Pear Seedlings	2,000	...	2,000
Peach Seedlings	6,000	...	6,000
Totals	394,692	27,952	422,644

MEADOW HAY.

H. G. ELLIOTT, Agricultural Adviser (Dairy Branch).

In the spring, when exceptional growth is obtained from our pastures, attention should be given to the conservation of fodders to tide over the long summer drought and early winter periods when grass growth is limited.

Two excellent forms of fodder conservation are meadow hay and silage. The former can be made and stacked cheaply, while the latter can be stored in pits, stacks, or silos at a very small cost per ton. It must be remembered, however, that a good reserve of both hay and silage is an insurance against bad seasons, and enables the farmer to increase the carrying capacity of his farm.

The gradual increase in quantities of hay and silage conserved per cow over the past three seasons is shown in the following table. These figures were obtained from the Better Dairying Competition conducted during the past three years.

	Reserve per Cow.					
	Hay.			Silage.		
	1933-34.	1932-33.	1931-32.	1933-34.	1932-33.	1931-32.
1—Average all Zones in Wet Districts	1.49	1.21	1.06	0.89	1.16	0.74
2—Average Zone 6 (Narrogin) ...	4.90	2.90	...	2.80	3.3	...

1—Receive 30ins. to 60ins. in rainfall

2—Receive 17ins. to 25ins. in rainfall.

Making Meadow Hay.

The value of meadow hay as a fodder for use, especially during the winter months, is gradually becoming a recognised fact for successful farming, and many farmers throughout the State are making a regular practice of keeping a portion of their pastures for this purpose.

Clover hay making often appears simple, but skill is required to obtain the best product, particularly when the weather conditions are uncertain. The aim of every farmer should be to obtain the maximum quantity of material rich in digestible nutrients.

Time to Cut.

The correct time to cut a clover pasture is when the bulk of the plants are coming into flower. Do not wait until full flowering, otherwise some of the valuable constituents of the product will be lost.

This is shown clearly in the following table. 100 lbs. of dry matter contains:—

	Digestible Crude Protein.	Production Starch Equivalent.	Phosphoric Acid.
	%	%	OZS.
Young Pasture 3ins. to 5ins. high ...	19	68	22.4
Hay stage Pasture (Flowering) ...	10.8	44	9.6
Mature stage Pasture (Dry) ...	4.5	30	6.4

From the above it can be seen that young clover is by far the best, but, as sufficient bulk would not be obtained for hay, it is advisable to cut it in the early flowering stage, as from then on to the mature stage a rapid decrease takes place in the valuable constituents. It also must be remembered that late cutting weakens the root stocks of young perennial plants, and prevents annual plants from producing an aftermath of good grazing value.



Ryegrass and Subterranean Clover being cut with a Special Divider.

[Block by courtesy of J. Leith Gillespie.]

Cutting and Handling.

A good mower with sharp knives, dividers, and a good swathing attachment is essential.

Leave each swath for a day or two to allow the exposed surface to dry sufficiently, after which it should be turned and left for a day to allow the other side to dry. After this operation the swathes are carefully put into windrows

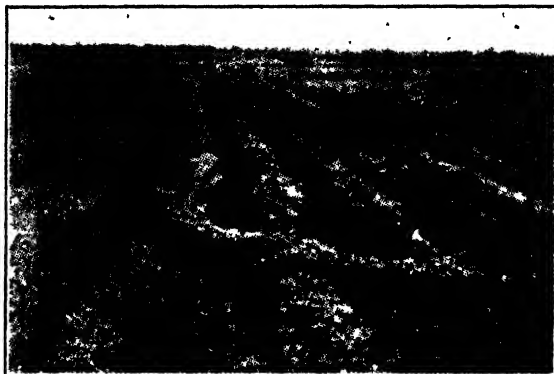


A heavy crop of Subterranean Clover is difficult to handle.

[Block by courtesy of J. Leith Gillespie.]

and then carted into the stack, avoiding, if possible, cocking. Careful handling is essential to prevent damage to, and loss of, the fine leaves. Given favourable weather conditions the hay should be in the stack on the third or fourth day after cutting.

Rain has a considerable damaging effect on hay, and every endeavour should be made to harvest in fine weather, even though it may mean an early or late cutting. It must be remembered, however, that while early cutting may mean reduced weights of hay, it is offset to a great extent by increased aftermath growth. Late cutting means a loss in value of the product, also loss of leaf material. This is probably better than a crop cut at the right time and damaged by rain.



If the Swath is left in this condition it will cure well
[Block by courtesy of J. Leith Gillespie.]

Stacking.

The material should be spread evenly over the stack and well tramped to avoid the formation of air pockets, in order to control fermentation and drying out.

Heat will be generated and charring produced if the material is too green or too damp when stacked.

SODIUM ARSENITE AS A WEEDICIDE.

G. R. W. MEADLY, B.Sc., Agricultural Adviser, Botanical Branch.

Sodium arsenite has been employed extensively for some considerable time as a weedicide, and until comparatively recently proved the most successful weed killer. During the last few years, however, chlorates, especially that of sodium, have become increasingly popular. Chlorates, being strong oxidising agents, are readily inflammable, and care must be exercised in this direction when handling them. On the other hand, arsenites, as well as being plant poisons, are fatal to animals if ingested even in small quantities. Chlorates of sodium and calcium are far less dangerous in this respect.

KILLING GREEN TIMBER.

The main treatment in which sodium arsenite is employed locally is the killing of green timber. Although the value of conserving a certain amount of timber on the farm must be stressed, when clearing is essential it is desirable to know the most efficient method.

Ring barking, if carried out thoroughly, is effective in most cases, but where time is an important factor the slow dying rate after this treatment alone causes inconvenience. When treated with sodium arsenite, however, the trees are killed much quicker and those which normally took months to die reach a similar stage in a few weeks. The actual time taken for the timber to dry, however, after the tree is dead is not appreciably affected by the presence of the arsenite. A number of our Eucalyptus trees also show a decided tendency to sucker, but if the chemical is applied under favourable conditions, this is reduced to a minimum. The most satisfactory time to carry out the work is when the tree is dormant, that is when the sap flow is at its lowest and the sap mainly located in the roots and lower portions of the trunk. Naturally the time of this condition varies with different trees and under different conditions, but in the South-West of this State the best time for application is from June to September.

At practically any time of the year a tree proper may be killed by ringing and applying sodium arsenite, but when the sap is down the tendency to form suckers is reduced.

THE MIXTURE.

Sodium arsenite may be purchased from wholesale chemists, but costs less if prepared on the farm. The following are suitable quantities for preparing a mixture to be used on green timber:—

- 1lb. white arsenic.
- 1lb. washing soda.
- $\frac{1}{2}$ lb. whiting.
- 4 gallons water.

White arsenic (arsenous oxide) is not readily soluble in water so that it is mixed with an equal weight of washing soda in order to convert it into water soluble sodium arsenite. The washing soda may be replaced by half its weight of caustic soda, but this is more expensive.

First dissolve the soda in a convenient amount of water, using heat if necessary to hasten the solution of the soda. Mix the white arsenic into a paste with water, and add slowly to the soda solution, stirring all the time. Place on a strong fire and boil for at least one hour, stirring from time to time. When the arsenic is all dissolved, add the whiting in the form of a thin paste and then make up to the required bulk by adding the necessary amount of water.

WARNING.

Avoid inhaling the fumes as far as possible owing to their unpleasant and injurious nature. Also do not allow the skin to come in contact with the mixture any more than is necessary owing to the caustic effect of the soda. Old gloves afford a certain amount of protection.

METHOD OF APPLICATION

By means of a series of downward strokes, "frill ring" the trees as close to the ground as possible. By making the axe strokes in one direction only and cutting into the heart wood, a frill is formed into which enough of the solution to run all around the frill is poured as soon as possible after the tree has been cut. For trees of 4 feet in diameter, about a quart of solution is required. This is easily applied by means of an old kettle or teapot, or a kerosene tin fitted with a tap and tube. The whiting included in the original solution serves to mark the trees which have been treated.

Every care should be taken with the solution as it is a virulent poison. Stock should be withheld from the treated paddock for at least three weeks after application. Vessels used in handling the solution should be retained for that purpose only, and kept out of the reach of children.

In order to secure satisfactory results it is essential that the work be carried out in a thorough manner. If the frill ring is not complete, or the solution not poured around the whole of the frill, good results cannot be expected.

KILLING WEEDS.

Besides being used for killing green timber sodium arsenite is also used for killing weeds growing on paths, etc. In this case the strength used depends upon the type of weed to be attacked. In the case of a strong growing perennial weed such as Nut Grass (*Cyperus rotundus*), 1lb. of white arsenic, 1lb. of washing soda, and 4 gallons of water gives a suitable solution, but for weak growing weeds such as Chickweed (*Stellaria media*), a 1.1.30 solution proves effective under favourable conditions. The solution may be applied by means of a watering can.

Weedicides such as arsenites and chlorates are often useful for killing weeds in small areas, especially gravel paths and tennis courts which cannot be dug up conveniently. On larger areas, however, where the weeds may be controlled by cultivation, poison sprays are not economical.

M. T. PADBURY TROPHY COMPETITION.

I. THOMAS, Superintendent of Wheat Farms.

The details of the judging of the following entries, which were shown as incomplete in the results of this competition published in the June issue of the Journal of Agriculture, have since been finalised, and are as follow:—

Order of merit in complete list.	Competitor.	Address.	Rainfall during growing period.	Area harvested	Yield.		
					Gross	Average per acre	Average per inch of growing period rain.
3rd	Haggerty, H. J.	Yarding ..	pts. 761	acres. 308.0	bus. lbs. 7,386 45	bus. lbs. 23 59	bus. lbs. 3 9
26th	Butcher, O. J. . .	Pithara .	1,378	244 5	6,629 54	27 7	1 58

The results of the entries of these competitors since the inception of the competition are shown below:—

Competitor.	Address.	Average yield per acre per inch of growing period rain			
		1930.	1931.	1932.	1933.
Haggerty, H. J. ...	Yarding	bus. lbs. 2 51	bus. lbs. *	bus. lbs. *	bus. lbs. 3 9
Butcher, O. J. ..	Pithara	*	*	2 42	1 58

* No entry.

THE TUNG OIL TREE.

(*Aleurites Fordii*, Hemsl.)

C. A. GARDNER, Government Botanist.

The Chinese wood-oil or Tung-oil tree, is a native of central and Western China, but is now cultivated commercially in various other countries, especially the United States of America. It is a deciduous tree which attains a height of 25 feet, and produces fruits somewhat the shape of a small orange, two to three inches in diameter. Each fruit contains three to seven firm brown seeds from which the oil is extracted.

The tree apparently shows little predilection in the matter of soils, but prefers well-drained hillside soils which are slightly acid. The type found most suitable in Florida is a sandy soil or sandy loam, which is underlaid with clay at a depth of from three to eight feet. The rainfall should not be less than 30 inches, 50 or even 70 being preferable. Experience in other parts of the world indicates that the Tung tree is comparatively resistant to dry conditions and high summer temperatures.

The oil expressed from the nuts is used especially in the manufacture of paints, varnishes and water proofing materials. Large quantities are also utilised in insulating compounds for cables, etc., and in dressing for leather and the manufacture of soap.

In 1931, one thousand seeds of this tree were obtained from the Royal Botanic Gardens, Kew, for trial purposes locally. These seeds were distributed to various parts of the State including Hamel, Bridgetown, Salmon Gums, Beneubbin, Broome, and Perth, but the results so far obtained are disappointing. A fair germination was secured at Broome, but the young plants were dried considerably by the hot winds. Apart from the Forests Nursery at Hamel, which raised 126 plants, no encouraging reports have been received. The young plants raised have been distributed to various places in the South-West, but results at this stage cannot be considered satisfactory. Two young plants in the Government Gardens are alive, but are not vigorous in their growth.

The local information so far secured regarding the Tung tree does not enable us to definitely advise regarding it, but the limiting factor seems to be the hot dry summer weather. The portion of the State most suited for the growing of this tree appears to be the South-West, but certainly further trials would have to be made before planting could be reasonably commenced on a commercial scale.

COST OF FEEDING COWS UNDER THE AUSTRALIAN OFFICIAL PURE BREEDS HERD RECORDING SCHEME, WESTERN AUSTRALIA, 1933-34.

G. K. BARON-HAY, Superintendent of Dairying.

R. A. PAUL, Herd Recorder.

In pursuance of the policy of the Dairy Branch initiated 11 years ago of recording the monthly fodders consumed by herds, which are checked on the occasion of the visits from the Herd Recorder, figures have been calculated with a view to ascertaining the average cost of feed for producing 1 lb. butter fat and 1 gallon of milk. In arriving at these costs, the various foodstuffs have been evaluated at the average prices ruling during the year, which are shown in Table 1.

TABLE 1.

Prices used in Valuing the Foodstuffs Consumed During Year Ending June, 1931.

					£	s.	d.
Chaff (oaten or wheat), per ton	..	..	..	..	4	8	0
Clover Hay, per ton	..	..	..	..	3	0	0
Silage, per ton	..	..	..	..	0	7	0
Wheat (crushed), per bushel	..	..	..	..	0	3	0
Oats (crushed), per bushel	..	..	..	..	0	1	11
Bran, per short ton	..	..	..	..	5	10	0
Pollard, per short ton	..	..	..	..	5	17	6
Linseed, per ton	..	..	..	..	12	10	0
Grains, per 75 lb.	..	..	..	..	0	0	6
Green Lucerne, per ton	..	..	..	..	1	0	0
Green Maize, Sudan Grass and Cereal Crops—							
(Chaffed), per ton	..	..	..	..	0	6	0
(Grazed), per head per week	..	..	..	..	0	2	6
Pasture, per head per week	..	..	..	..	0	1	6

During the last four years the cost of feed to produce 1 lb. of butter fat has approximated 7½d. per lb. and 3½d. per gallon of milk respectively, which is in marked contrast to the relatively high costs during the previous seven years. This indicates that owners of studs are studying carefully the cost of feeding their herds with the view of keeping this as low as possible and within economic limits. This is shown in Table 2 hereunder.

TABLE 2.—PURE-BRED COWS UNDER OFFICIAL TEST.

Average Results for last Eleven Years.

Year ending 30th June :	Average Milk Yield per Cow.	Average Butter Fat per Cow.	Average Cost of Feed per Cow.	Average Feed Cost to Produce 1 lb. of Butter Fat.	Average Feed Cost to Produce 1 Gallon Milk.	Average Value of Butter Fat per lb.
	gals.	lbs.	£ s. d.	pence.	pence.	pence
1924	600	319.50	10 4 10	7.7	4.09	19.5
1925	652	308.59	14 13 2	10.77	6.15	17.5
1926	624	312.01	14 14 7	11.15	5.66	19.0
1927	602	290.72	14 10 5	12.00	5.79	19.0
1928	592	280.56	15 11 4	13.34	6.34	19.5
1929	629	295.10	15 1 0	12.24	5.74	20.0
1930	636	294.98	14 10 3	12.74	5.10	19.5
1931	643	301.6	9 14 7	7.74	3.64	16.0
1932	696	318.96	10 18 3	8.21	3.76	14.0
1933	664	308.6	9 2 3	7.08	3.29	11.0
1934	720	333.7	10 2 6	7.28	3.37	10.0

It will be seen that the cost of feeding for the current year shows a slight rise over that for 1933, which is in part accounted for by a rise in the price of chaff (8s. per ton) and clover hay (5s. per ton). It also will be seen that the average production of cows for 1934 is higher than in any previous year, being 8.4 per cent. above that for 1933. It, therefore, would be expected that the feed cost for producing butter fat and milk would be lower per lb. in view of this higher production. The reverse, however, was the case, as the cost of producing butter fat showed an increase of 2.8 per cent. This is an indication that mere high production may not mean higher net profits unless the cost of feeding is scrutinised carefully by the farmer throughout the year.

With the unprecedented low price of butter fat during the past year, strenuous efforts are being made by farmers to reduce the cost of production, the greatest individual item of which is the cost of feeding.

One method by which costs have been reduced and yields increased is by a greater use of silage for feeding during the summer months. By means of this

fodder, herds situated in dry districts, such as Nungarin, Northam, York, Geraldton, and Koojan have been able to produce average yields comparable with those of herds more favourably situated geographically.

Table 3 shows that, with the use of silage, the cost of producing butter fat can be reduced approximately 9 per cent.

TABLE 3.
VALUE OF SILAGE IN FEEDING.

Cost of Production.	(A) With Silage.* d.	(B) Without Silage.† d.	Per cent. in favour of Silage. %
Cost of Feed per 1lb. Butter Fat produced	7.16	7.81	9
Cost of Feed per 1 gallon Milk produced	3.60	3.77	4.7
	* 12 Herds.	† 7 Herds.	

Without silage, it is believed that the production of good records in dry areas would be impossible without increasing the cost of production beyond what would be economically sound.

Table 4 shows that, for the 10 herds situated in the drier areas mentioned above, the cost of producing butter fat was 8.02d. per lb., whereas in the South-Western districts the average cost for the nine herds concerned was 6.7d., or approximately an increased cost of 20 per cent. for feed in the drier areas. This is a very serious disability, and indicates very clearly that in areas where green fodders are not available, the lactation periods of cows should commence early in the autumn, preferably in April or May, so that the nine months' period may be completed by December.

TABLE 4.—COST IN LIGHT RAINFALL AREAS COMPARED WITH HERDS IN THE SOUTH-WEST.

Average of	Production.		Cost of Feed for—	
	Milk.	Butter Fat.	1 Gallon Milk	1 lb. Butter Fat.
Dry Areas (10 Herds)	lb. 7,518	lb. 353.2	d 3.90	d. 8.02
Wet Areas (9 Herds)	6,427	314.6	3.39	6.70

As in previous years the three breeds under test have been compared as regards cost of feed for the production of milk and butter fat as shown in Table 5.

TABLE 5.—BREEDS COMPARED AS PRODUCERS OF MILK AND BUTTER FAT

Breed.	Average Yield of Butter Fat per Cow.	Average Test.	Average Yield of Milk per Cow.	Average Cost of Feed per Cow.	Cost of Food to Produce 1 gallon of Milk.	Cost of Food to Produce 1 lb. of Butter Fat.
	lb.	%	lb.	£ s. d.	d.	d.
Jersey (8 Herds)	319.2	5.2	6,023	9 0 9	3.60	6.92
Guernsey (5 Herds) ..	341.1	5.1	6,605	10 17 3	3.94	7.64
Illawarra Shorthorn Herds) (6	346.5	1.0	8,589	10 8 6	3.05	7.56

As is to be expected, the Jersey breed led as far as the economic production of butter fat is concerned, while the Milking Shorthorn excels as an economic producer of milk. When, however, the relative merits of the breeds are considered from the point of view of ultimate disposal as carcase meat and also the value of vealers and steers, the matter of which breed should be advocated becomes one entirely of individual preference.

Tables 6 and 7 give the herds under test in order of merit as producers of butter fat and as producers of milk.

TABLE 6.—HERDS IN ORDER OF MERIT AS PRODUCERS OF BUTTER FAT.

Herd.	Area— W, Wet; D, Dry.	Breed.	Average Production of Butter Fat per Cow for 9 months	Available Skim Milk per Cow.	Value of Butter Fat at 10d. per lb.	Value of Skim Milk at 1d. per gallon.	Gross Return for Fat and Skim Milk.	Cost of Feed per Cow for 9 months.	Profit per Cow by Sale of Butter Fat.	Cost of Feed to produce 1lb. of Butter Fat.
A	D	Guernsey	442.4	lb. 5,372	£ s. d. 17 1 2	£ s. d. 2 2 9	£ s. d. 10 3 11	£ s. d. 13 7 3	£ s. d. 5 16 8	d. 7.24
B	D	Jersey	400.5	4,785	15 6 3	1 19 11	10 3 11	13 6 0	4 0 2	7.97
C	W	Guernsey	397.3	5,160	15 2 9	2 3 0	17 5 9	10 7 4	6 18 5	6.26
D	W	Jersey	386.1	4,846	14 16 8	2 0 5	16 17 1	9 13 6	7 3 7	6.01
E	D	A.I.S.	377.1	6,899	14 14 3	2 17 6	17 11 9	7 12 4	9 10 5	4.84
F	D	do.	374.4	7,178	14 13 0	2 19 10	17 13 10	10 16 9	6 16 1	6.94
G	W	do.	361.4	6,413	14 1 2	2 13 5	16 14 7	10 14 5	6 0 2	7.12
H	D	Jersey	353.7	6,100	13 14 9	2 10 10	16 5 7	12 7 1	8 18 6	8.38
I	D	do.	339.3	4,218	12 17 9	1 15 2	14 12 11	12 3 9	2 9 2	8.62
J	W	do.	323.1	4,060	12 5 11	1 13 10	13 19 9	8 10 7	2 5 2	8.33
K	D	Guernsey	316.4	3,884	11 18 8	1 12 2	13 10 10	11 3 6	2 7 4	8.47
L	W	do.	315.0	3,720	11 17 6	1 11 0	13 8 6	9 12 8	3 15 10	7.34
M	D	A.I.S.	314.0	4,720	12 0 0	1 19 1	13 19 1	13 4 9	0 14 4	10.11
N	W	Guernsey	310.0	3,866	11 13 4	1 12 3	13 5 7	10 5 0	3 0 7	7.93
O	D	Jersey	307.9	3,625	11 11 8	1 8 0	12 19 8	5 17 0	7 2 8	4.56
P	W	do.	304.5	3,244	11 6 8	1 7 0	12 13 8	12 6 4	0 7 4	9.70
Q	D	do.	275.4	2,634	10 3 4	1 2 0	11 5 4	9 7 6	1 17 10	8.17
R	W	A.I.S.	235.4	3,293	8 15 2	1 7 5	10 2 7	7 0 7	2 13 0	7.62
S	W	Jersey	229.7	2,650	8 6 8	1 2 1	9 8 9	7 17 8	1 11 1	6.93
Average...	...	...	333.7	4,744	12 14 1	1 19 6	14 13 7	10 2 6	4 11 1	7.28

Skim Milk available for use (after rearing (tail) = {Milk Production — 60 gallons} — 10⁰.) — 120 gallons.

TABLE 7.—HERDS IN ORDER OF MERIT AS PRODUCERS OF MILK.

Herd.	Breed.	Average Yield of Milk per Cow for 9 months.	Value of Whole Milk at 1/- per gallon.	Cost of Food per Cow for 9 months.	Profit over Cost of Feed.	Cost of Food to produce 1 gallon of Milk.
		lb.	£ s. d.	£ s. d.	£ s. d.	d.
F	A.I.S.	9,909	43 8 7	10 16 9	32 11 10	2.86
E	do.	9,599	40 19 10	7 12 4	33 7 6	1.90
G	do.	9,059	38 5 10	10 14 5	27 11 5	3.10
H	do.	8,711	36 11 2	12 7 4	24 3 10	3.36
A	Guernsey	7,902	33 5 3	18 7 3	19 18 0	4.05
C	do.	7,666	31 16 7	10 7 4	21 9 3	3.24
D	Jersey	7,317	30 1 9	9 13 6	20 8 3	3.17
B	do.	7,250	30 0 0	18 6 0	16 14 0	4.40
M	A.I.S.	7,178	29 1 10	18 4 9	15 17 1	4.42
I	Jersey	6,620	26 12 0	12 3 9	14 8 3	4.44
J	do.	6,444	25 14 6	8 10 7	17 3 11	3.17
K	Guernsey	6,249	24 14 11	11 3 6	19 11 5	4.29
N	do.	6,229	24 12 11	10 5 0	14 7 11	3.95
L	do.	6,066	23 16 7	9 12 8	14 3 11	3.81
O	Jersey	5,961	23 6 0	5 17 0	17 9 0	2.85
R	A.I.S.	5,592	21 1 3	7 9 7	13 11 8	3.21
P	Jersey	5,538	21 8 9	12 6 4	9 2 5	5.33
S	do.	4,878	17 17 0	7 17 8	10 0 1	3.87
Q	do.	4,860	18 1 0	9 7 6	8 13 6	4.63
Average		7,204	29 8 6	10 2 6	19 6 0	3.37

TABLE 8.

Summary of Results, 1933-34.

The average pure bred cow under official test produced in nine months:—

(1) 7,204 lb. milk.

(2) 333.7 lb. butter fat.

	£ s. d.
Value of Butter Fat @ 10d. per lb.	12 14 1
Value of Skim Milk @ 1d. per gallon	1 19 6
Total return	14 13 7
Cost of Food for 9 months	10 2 6
Net Return from Sale of Butter Fat ..	£4 11 1
Value of Whole Milk @ 1s. per gallon	29 8 6
Cost of Feed	10 2 6
Net Return by Sale of Whole Milk ..	£19 6 0
Cost of Feed to produce 1 lb. Butter Fat	7.28d.
Cost of Feed to produce 1 gallon Milk	3.37d.

STALLION SUBSIDY SCHEME.

In order to assist the draught horse breeding industry in this State, particularly with the object of providing good quality horses for farm work, the Government in 1928-29 made available a sum of money from which subsidies would be paid for the purchase of approved stallions, the settler only being required to pay half the landed cost of the animal. This subsidy has been continued each year since that time, including the present year, and up to date 91 horses have been obtained, the majority from the Eastern States, and distributed widely. There is no doubt that this policy has had an appreciable effect on the quality of our farm horses. This will be realised when it is stated that the animals purchased must have a Government certificate to the effect that they are free from any hereditary or transmissible unsoundness or disease, and are registered in the stud book.

In order that the animals may be fully utilised it is also provided in the conditions under which the subsidy is granted that the horses must travel in the districts in which they are situated for at least three years, and that the maximum fees to be charged shall be—

Ordinary service	£4 4 0
(Guaranteed service)	£6 6 0

and the owners of the stallions are required to advertise these conditions in three consecutive insertions in the local Press.

The following is a list showing for whom horses were purchased this year, and the approximate landed cost:—

	£
E. Ludeman, Watteneng—"Newbold Belmont"—Sire "Brunstane Demand" (21591 C.S.B.), Dam "Widgieva Winsome" (2019 C.S.B.)	210
Senator P. J. Lynch, Three Springs—"Fyvielea Pearl" 2636 N.Z.C.S.B. Sire "Fyvie Baronet" (21071 C.S.B., imp.), Dam "Violet Morocco" (4853 N.Z.C.S.B.)	200
N. Lemmon, Ongerup—"Cracksman" 2743 N.Z.C.S.B.—Sire "Hero Bold" (2168 N.Z.C.S.B.), Dam "Lorraine" (3158 N.Z.C.S.B.)	200
W. Waddell, Carrabin—"Veradale Roderick"—Sire "Everlasting Dale" (616 C.C.S.B.), Dam "Veradale Rosie Dale" (2563 C.C.S.B.)	180
Nelson Pearce, Mingenew—"Roselyn Radiant"—Sire "Melrock Roy Dale" (1290 C.C.S.B.), Dam "Dunira Tilly"	290
Chivers, H., Yandanooka—"Oakleigh Brown Kinloch"—Sire "Kinloch Hero" (2176 N.Z.C.S.B.), Dam "Dorah Douglas" (1893 C.C.S.B.)	190
Metcalf, H., Dowerin—"Gallant Treasure"—Sire "Bright Treasure" (575 C.C.S.B.), Dam "Lady by Fabric Again" (617 C.C.S.B.)	170
O'Connor Estate, Toodyay—"Oakdale Balnakill"—Sire "Buchlyvie's Choice" 110 C.C.S.B.), Dam "Lady Glendale" (1835 C.C.S.B.)	330
Taylor and Sons, Dangan—"Brackenhurst Monarch"—Sire "Vue Dale" (772 C.C.S.B.), Dam "Madame Dale" (1391 C.C.S.B.)	140
S. Hunter, Yandanooka—"Anama Cashier"—Sire "Scottish Banker" (20647 C.S.B.), Dam "Widgieva Iris" (1644 C.C.S.B.)	180

MULLA MULLA.

(*Trichinium alopecuroides*, Lindl.)

A Native Forage Plant.

C. A. GARDNER, Government Botanist.

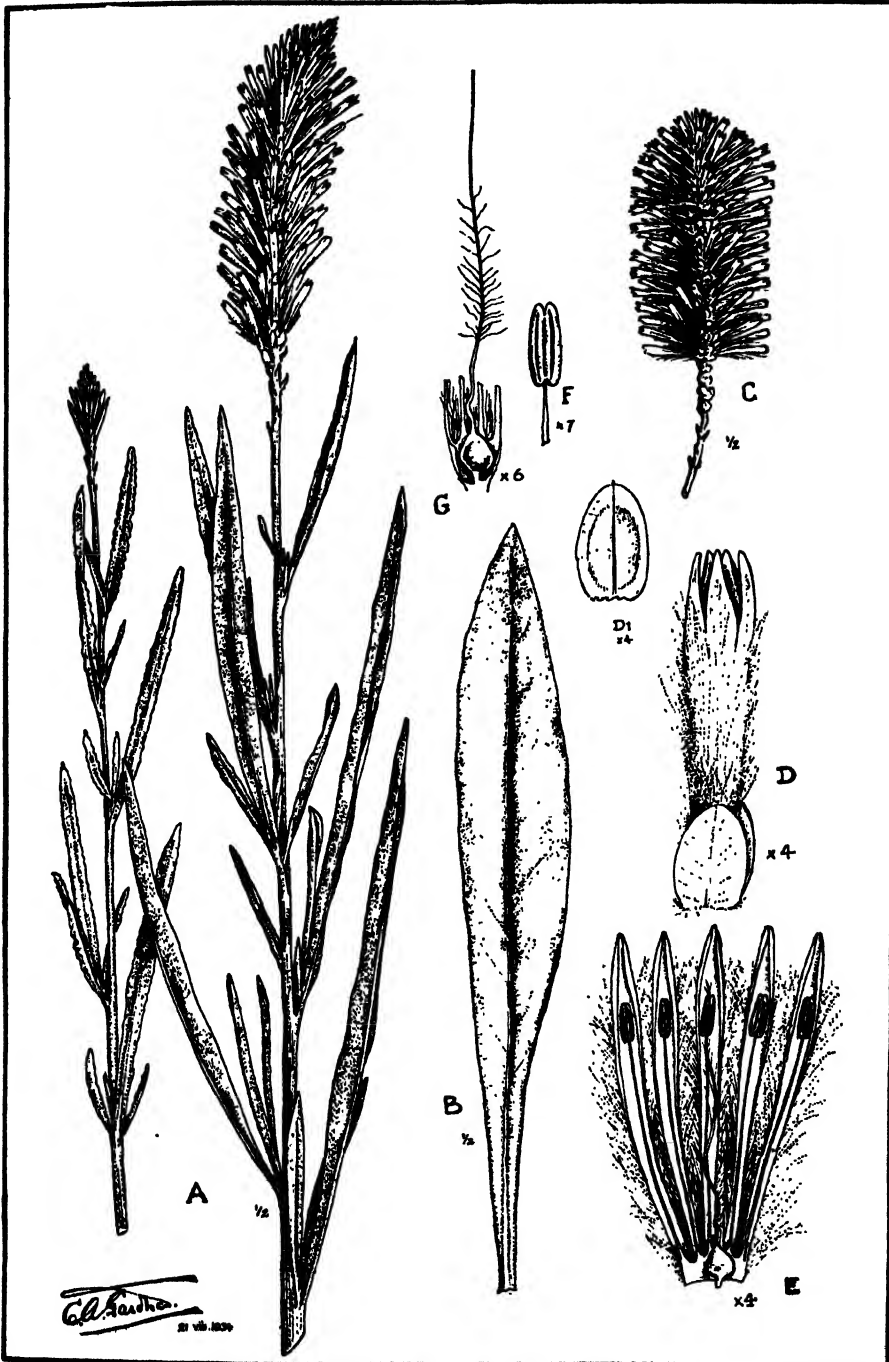
Several species of the genus *Trichinium*, one which is purely Australian in distribution, are valued forage plants in the arid and semi-arid parts of the continent. In the North-West and North they form a valuable portion of the herbaceous forage on stock runs, and stock appear to seek after the plants in preference to most other species, including grasses. One of the most wide-spread and best known of the species is the one dealt with herein—*Trichinium alopecuroides*, the common Mulla Mulla of the pastoral areas. The range of this plant extends from Kimberley almost to the south coast,* and inland to the eastern boundary of Western Australia. Having such an extensive range it is known to most pastoralists, and recently the plant is becoming known in the agricultural districts, especially in the lighter soils of the wheat lands which it is successfully invading, although much handicapped by the fact that stock keep it in check through eating it down, thus giving it little chance to spread. It thrives on ploughed sand-plain soils, and in the lighter granitic loams of the eastern districts.

The species assumes two distinct forms, according to soil and climatic conditions. The common form of the South-West and Eastern Districts is an almost shrubby perennial herb attaining a height of three or more feet, possessing a strong tap-root and numerous almost woody spreading stems, from which arise erect herbaceous branches bearing soft leaves and spikes of greenish-yellow flowers at first erect, but as they elongate becoming drooping in the upper portions. All classes of stock, but especially sheep and horses, are fond of the leaves and flowers.

The northern form, which is found from the East Murchison northwards, is a smaller plant with a few stiffly erect herbaceous stems and wide cylindrical erect spikes of yellowish flowers. The plants rarely exceed eighteen inches in height, and possess little in the way of foliage except the basal leaves. With this form of the species it is principally the flower-heads which are of value as forage.

The Mulla Mulla is being spread principally through the agency of stock, and to a less extent the seeds are wind-borne. The flowers in the fruiting stage expand their segments, and being light, the whole is easily carried by wind. Stock perhaps distribute the seeds in part through their droppings, and in part through the seeds in the flowers adhering to wool or hair. In the light sandy ploughed soil of the sand-plains the plant has found a suitable environment, and allowed to seed readily spreads itself. Its value in the drier areas is that it thrives under conditions which are too dry for most forage plants, or in soils of the poorest quality agriculturally, and that it makes vigorous growth during the dry period of the year when most feed is scarce.

Seeds of Mulla Mulla are not obtainable commercially. The plants produced from seeds are relatively few when the production of seeds is considered. This may be due to the low production of viable seeds, or that the conditions necessary for their germination are not met with everywhere. Where plants are in existence it is advisable to allow them to produce seeds occasionally, and to encourage the plants to spread in unused ground rather than to attempt establishment by obtaining seeds.



"Mulla-Mulla."

(*Trichinium alopecuroides*, Lindl.)

Kellerberrin.

EXPLANATION OF PLATE.

- A. Habit. B. Leaf. C. Flower-spike. D. Flower with two basal bracteoles. E. Flower opened, showing internal structure.

Kellerberrin, W.A.

Icon. origin.

EXPORT EGGS.

G. D. SHAW, Poultry Adviser, Department of Agriculture

The export season is in full swing and it will be of advantage to review the activities.

Eggs are arriving for export in increasing quantities each week, and there is a marked improvement in cleanliness and packing, but it must be impressed upon producers that any egg showing the slightest stain is rejected and paid for as an "export reject." A little more care would help to keep down the numbers of eggs condemned.

It has been stressed that eggs should be collected twice daily and wiped with a damp cloth. By wiping immediately the eggs are collected the advantage of the animal heat of the egg helping to dry the moisture from the damp cloth is retained, and the egg dries immediately it is wiped. Do not allow the eggs to stand all day or overnight, as it needs a double process of handling, wiping with a damp cloth and drying with the dry one.

Stains.

Stains are the result of several causes. The most prevalent being fouled nesting material.

A stain which has been allowed to "dry in" the shells cannot be removed. It can be erased while cleaning, but will certainly show up after the egg is dry. These stained eggs, although fresh, cannot under any pretence whatever, be classed as clean. They do not look inviting and if they were exported would not enhance the reputation of our eggs overseas.

Misshapen Eggs.

Misshapen eggs fall into the producer's crate with regular precision only to be rejected on inspection at the export floors. If producers would only understand that a misshapen egg is due to some mismanagement, and eliminate the trouble, they would help themselves considerably.

Whole lines have come forward with ridges around the centre, which is caused more or less by bad breeding. Continued hatching of misshapen eggs results in an increase in the succeeding generation. Do not breed from a misshapen egg.

The long thin egg, the round one, that with a ridge, and the egg which is all crinkles, are classed as misshapen and are all caused through breeding faults.

Thin Shells.

Thin shells are now a fault which will increase in the near future, due to the shortage of shell forming material in the bird's body.

Plenty of shell grit does not necessarily mean good shells. Bonemeal in large quantities may not mean an improvement in shell texture. The improvement will only come about by the bird's ability to assimilate the shell grit and bonemeal into her body. She will eat plenty but may not be able to use it.

The hens may need a tonic; therefore, as the season develops look to the condition of the birds and regularly examine the egg for shell texture. If the flock is in good condition the addition of more bonemeal will be an improvement and it should be added until it is found there are superficial spots of lime on the egg. The supply can easily be adjusted from that point.

Watery Whites.

The term "watery whites" is hardly understood by either the average producer or consumer.

Consumers have a bad habit of classing any egg whose albumen is weak and watery as a stale egg. It has often been found that the newly laid egg when broken into a frying pan, has run all over the pan as if stale. That watery condition of the white has led to the classification of "stale" which is an injustice to many an honest producer. No trouble has been taken to observe the yolk. A new laid yolk stands right up inside the white, but the stale yolk shows a distinct flat lifeless appearance.

Watery whites cannot be seen by the candling process. Watery whites are said to be caused by the wrong feeding of green material. Very seldom are they noticed in eggs from a farm which regulates the feed scientifically.

Where fowls can obtain an over-abundance of succulent green feed so one can expect "watery whites."

Broken Down Air Cells.

Broken down air cells are often called "watery whites" but the causes are totally different.

It is now universally advocated that all eggs should be packed "big" end up, which allows the contents of the egg to be retained in its natural way. If the eggs are packed with the air cells downwards the contents are resting on the tender membrane of the air cell. Vibrations, due to rough handling and transport, cause the contents to rest heavily on the air cell, and the membrane is drawn away from the shell. When candled the air cell works around the egg and is of little use for export if badly damaged. With big end downwards, heavy vibrations may rupture the air cells and the air then mixes with the contents and causes bubbles to join in the egg.

A few years ago, we were advised to pack air cells downwards as any cracked egg retained its contents and did not stain its neighbours. The results of recent years have convinced packers of the fallacy of this advice, as more eggs are damaged through having "wobbly" air cells than through the stains due to cracked eggs.

Stale Eggs.

The summer is fast approaching, and already eggs of doubtful age are arriving on export floors. Produce must be marketed frequently and despatched through the shortest channel to the export floors.

A marked improvement has been noticed in receipts from country storekeepers. The eggs are coming forward fairly frequently, and there is no excuse for not forwarding twice a week at least.

Rejects.

Keep all known "rejects" out of your export consignments. They must certainly be marketed but label them separately. Be fair to the purchaser of those rejects by labelling the contents what they are and not what you would like them to be.

A recent incident of an unfair designation will appeal to most producers.

It was necessary to inspect a case of eggs recently with a view to condemnation. The case was labelled "Standard" New Laid, meaning that every egg was laid within 7 days, and all clean and of 2ozs. and over in weight. On examination, the case was found to contain nothing but cracked and filthily stained eggs, certainly under 7 days old, but the grade was anything from 1½ozs. to 2½ozs. That case was labelled "Standard" New Laid Eggs. A glaring case of misrepresentation under the Agricultural Products Act, 1929. Such eggs could only come under the third grade of goods, and should have been classed as "cooking" eggs.

THE OLEANDER.

(*Nerium Oleander*, Linn.)

A Decorative Shrub and Toxic Plant.

C. A. GARDNER, Government Botanist.

The Oleander, commonly grown in gardens in many parts of the State, is valued as one of the most handsome of our summer flowering shrubs, the bright green foliage and single or double flowers of white, pink, or red, together with the sweet and heavy perfume, making it attractive, especially in country districts. The plant is very hardy, and, when once established, will thrive in dry localities with very little water under conditions in which the White Cedar or so-called Cape Lilac has difficulty in growing. The plant may be seen on many stations through the Murchison, Gascoyne, and Ashburton districts, and there is no reason why it should not be cultivated more extensively in the wheat areas.

Although the species is so familiar, it is perhaps not generally known that the plants are highly toxic, and cases of poisoning, both in animals and the human species, are by no means rare, and thus it is important that care should be taken with children plucking the blooms, in case they might be eaten, and stock should be excluded from areas where the plant is grown. Local cases of poisoning are on record from stock having eaten leaves from the shrubs. The flowers, leaves, wood and roots are all poisonous, and Professor Henslow records that during the Peninsular War a number of French soldiers who went out foraging near Madrid returned laden with the fruits of their search, and that one of the number, with a view of securing some wood to make skewers for the meat, cut a quantity of Oleander boughs, and having stripped off the bark, used the wood in the meat. The result was that, out of twelve who ate the meat, seven died, and the rest were dangerously ill. The poisonous principle is said to be so subtle that its exhalations alone have been known to cause serious accidents and even death to those who sleep for any length of time under its influence.

The Oleander is native to India, and is supposed to be the willow of Scripture.

Farmers and others are warned against admitting stock to areas in which the plant occurs, especially if feed is scarce.



"Oleander"
Nerium oleander

"TOXIC PARALYSIS" OR BOTULISM IN SHEEP AND CATTLE.

A. McK. CLARK, L.V.Sc.,

Chief Veterinary Surgeon.

The attention of sheep and cattle owners is drawn to the presence of this disease, which is the cause of serious mortality amongst their flocks and herds during the summer months. It is especially in evidence in the Wheat Belt. The losses are considerable, and it may even be said that toxic paralysis takes the greatest toll of all diseases during the year. The purpose of this article is, therefore, to give due warning to those owners whose sheep and cattle have been, or may be, affected with this troublesome disease in order that steps can be taken to prevent losses from this cause during the coming summer. The reason for toxic paralysis becoming more evident is attributed to the following:—

- (1) Long dry summer—(Lack of minerals in pasture).
- (2) Lighter distribution of superphosphate—(Less mineral in the soil).
- (3) Greater number of dead rabbits—(Infected carcasses available for ingestion).

Causes.—This disease is prevalent in many of our districts amongst cattle owing to a mineral deficiency in the food supply. Milking cows in particular constantly require supplies of phosphate in order to remain healthy. Cattle will attempt to make good their mineral requirements, when pastures are deficient, by chewing bones, which are rich in the necessary elements. If mineral deficiency is very marked the animal's appetite becomes more and more depraved, with the result that all kinds of rubbish is eaten. There is in most districts a germ (*Bacillus botulinus*) which occurs in the soil and infects carcasses of animals—cattle, sheep, rabbits, etc. It is found, and, by reason of its great resisting powers, may remain for considerable periods, in bones of dead animals. This bacillus or germ produces a powerful toxin or poison. When the bacilli or toxins are ingested (with bones or parts of carcasses which are infected with them), particularly by cattle, in the great majority of cases fatal results ensue. Carcasses of animals which have died from the disease are, of course, very dangerous. The disease produced is sometimes known as "Dry Bible" or "Toxic Bulbar Paralysis."

The rabbit carcase-eating habit is developed in sheep owing to continued feeding during the long dry summer on stubble and other pastures which are deficient in phosphates. It will not become evident in the winter months, but usually in the middle or end of the summer.

In order that this disease may occur on a property two factors are essential—

- (a) Mineral deficiency.
- (b) Presence of bacillus botulinus.

SHEEP.

Symptoms.—Sheep mostly affected are young sheep and in good condition. In some cases the initial symptoms appear to be wriggling of the tail as though fly-blown. Later they show a stiff gait and a disinclination to move, progressing only for a short distance and then lying down. The animal appears dull and does not attempt to eat. When standing, the head is held in a drooped position, frequently with the lower jaw hanging down. From the open mouth a more or less profuse flow of saliva occurs. In advanced cases respiration is spasmodic and abdominal. Finally the animal is unable to rise, and dies quietly without a struggle. The mortality is usually in the vicinity of 10 per cent.

Prevention (remedying deficiency).—Cure by treatment is not known, therefore preventive measures, which are known to be successful, should be adopted. It is essential that the full mineral requirements of sheep during the summer months be supplied in order that the craving for rabbit carcasses and other debris be satisfied. It is estimated that the optimum daily intake of phosphoric acid for two-tooth ewes weighing 80 lbs. is about $\frac{1}{8}$ oz. For 100 sheep for a week this would be $5\frac{1}{2}$ lbs. The amount of phosphoric acid which 100 sheep would obtain, in one week, from our summer pasture, is about 3 lbs., and in parts of the wheat belt may be even less. This leaves a deficiency of $2\frac{1}{2}$ lbs. of phosphoric acid. This would be provided in 14 lbs. of dicalcic lick having an 18 per cent. phosphoric acid content. This should, therefore, be taken as a minimum amount of lick to be provided in the wheat belt. That is approximately $\frac{3}{8}$ oz. of dicalcic lick containing not less than 18 per cent. phosphoric acid per sheep per day.

Oats.—Oats are often fed to sheep in this State, and it is interesting to note the phosphoric acid content of this important feed. 1,000 lbs. of oats contain 8 lbs. of phosphoric acid. If oats are fed at the rate of 1 lb. per sheep per day they will supply in one week to 100 sheep about $5\frac{1}{2}$ lbs. of phosphoric acid; this is the required amount of minerals.

Licks.—The question is, therefore, "What lick to use?" It has already been pointed out that this should be a *dicalcic lick containing not less than 18 per cent. phosphoric acid*. Bonemeal has been used with success for this purpose, but it has been shown by recent investigations that dicalcic phosphate, weight for weight, is three times as effective as bonemeal. Therefore dicalcic phosphate is the most economical and efficacious mineral to use as a lick for the purpose of supplying the necessary minerals to sheep in order to prevent that craving for carcasses and debris, and consequently prevent infection with the germ which is the direct cause of toxic paralysis. It is recommended, therefore, that sheep on the wheat belt be supplied with a lick, during the summer months, which can be made up as follows:

Commercial dicalcic phosphate	..	..	45	parts.
Commercial Salt	..	..	40	"
Molasses	..	..	5	"
Water to condition	..	..	10	"

In addition, of course, all rabbit carcasses and bones should be collected and burned or buried deeply.

This lick is odourless and devoid of any taste and its purity is unquestionable. It should be supplied in wooden containers and placed near the water supply. If sheep are unaccustomed to licks, care should be taken to make them familiar with them. Should they disregard them the addition of a little oats or wheat germ will attract them. This may be excluded after the sheep take freely to them. It may even be necessary to yard the sheep at night, at the same time placing the licks in the yard with them. Phosphatic licks should not be taken away from sheep as a matter of course at the beginning of the winter, but should be continued until the sheep refuse to take them. In all cases they should be made available each year not later than September. It must be pointed out that where toxic paralysis is prevalent amongst sheep a lick containing not less than 12 per cent. phosphoric acid would be necessary in most cases. Also that because licks are taken freely is no indication as to their efficacy.

Other Beneficial Effects.—Apart from the losses sustained by sheep contracting toxic paralysis through the ingestion of infected material, a lack of phosphates in the food supply decreases the food consumption, with the result that an economic loss ensues through the sheep not making the best use of the available pastures.

CATTLE.

Symptoms.—Dairy cows are particularly affected, whilst despasturing; cattle during the summer months are affected to a lesser extent. Cows at the height of milk production require large quantities of minerals for milk secretion. The symptoms produced are due to paralysis of certain portions of the nervous system by the toxin (or poison) of the invading bacillus. In typical cases the animals are unable, or with difficulty, to masticate or swallow feed. In the early stages there is difficulty in drinking, later no feed or water is taken. There is excessive salivation and sometimes protrusion of the tongue. The gait is more or less staggering (partial paralysis), and the animal is dull. Rumination (cudding) is disturbed and finally suspended, and the faeces are scanty. Progressive weakness ensues, the animal lies down and can be got to rise only with difficulty or not at all. Eventually, in from two days to a week after symptoms are first noticed, the animal sinks into a state of coma (sleep) and dies. These characteristic symptoms are not always shown. In very acute cases death is sudden; other cases may be of longer duration than described, the affected animals showing general unthriftiness, loss of condition and a cripplly gait. The bone-chewing habit is constant in all cases.

Prevention.—As treatment is of no avail, preventive measures should be adopted. In mild cases assistance can be given by giving a drachm of powdered Nux Vomica in the food supply three times daily. Drenching should not be attempted owing to the inability of the animal to swallow and the consequent possibility of choking.

Licks.—Prevent mineral hunger and the consequent depraved appetite by supplying phosphates. Bonemeal has been successfully used in the past but a cheaper substitute is now recommended, known as dicalcic phosphate. The latter is three times more effective in similar weights as bonemeal. Dicalcic phosphate should be given in quantities of 2 oz. per cow per day in the food supply, or in the form of a lick which is made up as follows:—

Commercial dicalcic phosphate	..	..	45	parts.
Commercial salt	..	..	40	„
Molasses	..	..	5	„
Water to condition	..	..	10	„

In the event of this lick not being freely taken by cattle, a little linseed meal should be added only until the necessary liking is developed.

All carcases and old bones should be removed from the paddocks which are carrying stock and buried deeply, or preferably burned.

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum.	Minimum.	Mean.	Highest.	For Month.	Aver. age.	Maximum.	Minimum.	Mean.	Highest.	For Month.	Aver. age.	Maximum.	Minimum.	Mean.	Highest.	For Month.	Aver. age.
Chapman State Farm	65.5	74.9	45.7	38.3	4.50	63.7	70.0	42.8	34.8	3.74	3.06	68.6	82.0	47.0	39.5	2.71	2.79	
Alfredalton	67.7	76.0	51.5	40.0	4.06	66.2	70.1	50.2	31.0	3.06	3.00	69.7	81.1	51.8	41.0	1.68	2.00	
Wabington	61.6	61.1	43.0	37.1	4.19	60.0	65.8	40.1	40.4	3.59	2.78	69.7	75.0	41.3	34.0	2.27	3.13	
Perth	63.9	73.0	49.9	40.5	11.41	63.0	68.6	48.9	37.0	5.89	6.74	65.5	76.0	48.5	40.2	5.65	5.74	
Kalamunda	61.0	74.7	47.1	39.7	12.07	64.2	64.2	45.7	39.0	8.39	8.54	62.0	72.0	46.0	39.2	6.76	6.91	
Bunbury	64.1	70.7	47.7	38.1	4.67	62.6	68.0	46.4	37.2	5.68	6.42	64.2	69.3	46.3	37.2	5.80	5.56	
Bridgetown	61.5	71.5	42.0	29.2	6.46	60.0	66.5	39.6	31.0	2.24	2.79	64.2	73.0	49.6	32.2	4.44	5.10	
Albany	62.6	70.9	49.5	38.8	5.04	61.1	69.3	47.7	40.0	5.90	5.60	63.2	72.0	45.8	39.4	6.32	5.58	
Merredind State Farm	61.5	72.3	43.4	34.3	1.93	61.1	67.8	39.0	28.4	1.85	1.49	64.6	72.0	45.0	20.5	1.47	1.52	
Northam	63.2	73.0	53.6	34.0	4.01	62.1	68.0	41.8	32.0	3.17	3.49	65.6	72.0	42.3	33.0	1.56	2.01	
York	62.1	70.5	43.0	32.0	3.94	60.6	69.0	40.8	31.5	2.89	3.43	61.3	71.0	41.3	31.5	1.71	2.83	
Narrogin State Farm	58.9	66.5	43.2	32.6	4.64	64.2	64.2	40.8	32.7	3.01	4.24	61.0	71.0	41.0	30.7	2.46	2.47	
Katanning	57.7	65.6	44.2	31.7	3.41	58.0	64.2	42.0	31.7	2.62	3.10	60.8	70.7	41.0	30.7	2.46	2.47	
Cape Leeuwin	63.3	74.5	53.7	48.0	5.62	62.0	52.3	67.6	47.0	7.99	7.52	62.5	69.0	52.5	45.0	6.39	5.58	
JUNE, 1934.																		
JULY, 1934.																		
AUGUST, 1934.																		

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THE LOCUST MENACE.

(*Chortoicetes terminifera*.)

By L. J. NEWMAN, F.R.E.S., Government Entomologist.

The man on the land has, indeed, many and varied troubles to face.

Apart from the vicissitudes of markets, his life is a never ending fight against adverse forces of nature. He has to battle with the rabbits and other vermin, and weeds, and now he is faced with the problem of locust control. The order of insects to which the locust belongs is known as the Orthoptera. The word Orthoptera is derived from the Greek, Orthos straight and Pteron a wing, and refers to the fact that all the winged members of this order are provided with a pair of primary wings not used in flight, but which, when the insect is at rest, are folded back in a straight line with the body, covering the secondary or membranous flight wings.

Locusts are all known as mandibulate insects, that is they are provided with mouth parts, which enable them to bite or chew their food. It is very important to know whether an insect chews or sucks, as this largely governs the method of control. The natural habitat of the locust is hot or temperate regions containing areas of dry or semi-arid lands and where the climate is subject to varying conditions of rainfall. Perhaps of all insect pests the locusts are most to be feared. They are general vegetable feeders and attack in gregarious or massed formation, and soon lay waste a crop of wheat, pasture, or fruit. Other insects may do an equal amount of damage during the year, but it is more gradual and is not done whilst we look on, so to speak. With the growth of agriculture, settlement has been pushed northwards and eastwards into districts which a few years ago were considered of little use from an agricultural point of view, and in so doing we have encroached upon the natural breeding grounds of the locust.

The clearing of the timber and scrub has brought about a considerable reduction of the insectivorous bird life, which is always a great factor in the control of insects. The ringbarking and destruction of the timber has materially altered the topography of the country and has removed the natural barriers which confined the pest to certain natural areas. It has also opened up the way for a westward spread of the locust. Lands so cleared do not naturally produce much growth unless broken up and cultivated. These conditions of open, bare areas have been readily taken advantage of by the invading locusts, and instead of returning to their natural breeding grounds, they have established themselves in the new artificially created breeding grounds. In recent years the position has been greatly aggravated by cleared lands throughout the locust areas which, for various reasons, have been put out of cultivation. Every such uncultivated area, for instance stubble paddocks not cropped or fallowed the following season, until they become grassed, is a

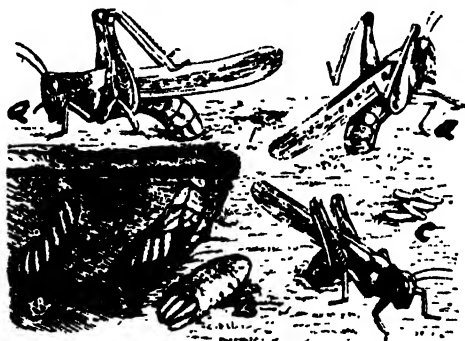
definite menace to the agricultural and pastoral industries, on account of army worms, other insects and pests, in addition to the locusts.

The addition of these artificial breeding grounds within the wheat areas to the natural breeding grounds has rendered the locust position more dangerous and difficult, and sooner or later, if action is not taken to prevent it, there will be a recurrence of the damaging swarms which so seriously attacked the crops and pasture in the new farming districts some years ago.

It is not only in the immediate areas where the locusts are bred that the danger exists, for, when a swarm becomes winged, crops or grass many miles away may suffer. Fortunately the locust with which we have to deal in the wheat areas does not usually migrate long distances as do some species in other parts of the world. A flight of 10 to 20 miles is, however, not uncommon, when the pest is pushed for food. It therefore behoves farmers in any portion of a road board area or district to be very interested in any outbreak that may occur in such area.

The initial swarms of hoppers may only affect those crops in the immediate vicinity, but it must be remembered that these same hoppers, if not destroyed, eventually become winged, and crops many miles away from the hatching grounds may be attacked and destroyed. It is therefore obvious that an outbreak in any district is of common interest to all and should be attacked co-operatively.

It is recommended that each infested district combine through its road board or other constituted medium, to make a co-operative effort for the destruction of the pest. This is essential not only to protect the other fellow, but from the more selfish motive of self-preservation. The great difficulty during previous outbreaks has always been the man with the crop not immediately endangered, who refuses to co-operate in efforts made to suppress the plague whilst in the hopper stage. This same farmer later on finds his area suddenly invaded by winged swarms of hungry locusts, which rapidly make short work of the ripening crops. Once on the wing, the control of this pest is rendered almost impossible and very costly. If attacked in the young hopper stage they can be successfully and economically poisoned.

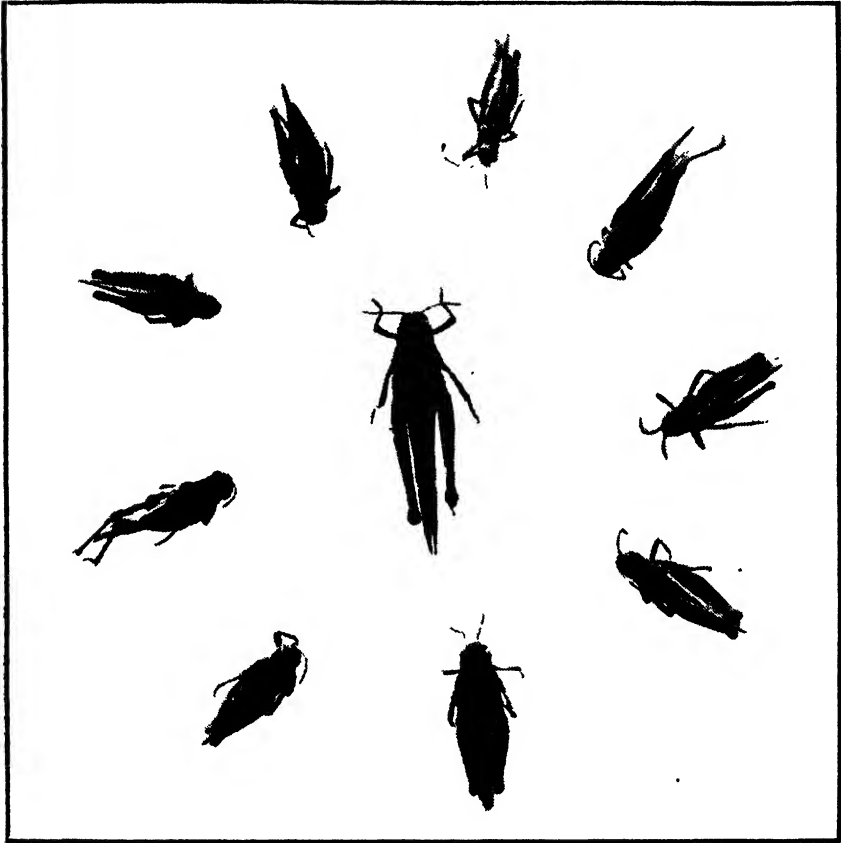


Female locust in act of laying. *a, a, a*, female in different positions, ovipositing; *b*, egg-pod extracted from ground, with the end broken open; *c*, a few eggs lying loose on the ground; *d, e*, show the earth partially removed, to illustrate an egg mass already in place and one being placed; *f* shows where such a mass has been covered up. (After Riley.)

THE LIFE HISTORY OF THE LOCUST.

The eggs are laid in almost any kind of soil, so long as it is compact; hard stubble paddocks, ringbarked, ungrassed country, roadsides, sheep pads, headlands around crops, etc., are favoured places for egg deposition.

The female locust, when about to lay, selects a suitable location. By means of two pairs of hard horny valves, situated on the posterior extremity of the body, she bores a hole in the soil from 1 to 2 inches deep. These horny appliances or valves are so constructed that, when opened and shut by the muscular action of the body, they function in much the same manner as an auger. This act has been witnessed many times and been known to take up to 3 hours.



Typical ring of males as seen around egg-laying female

[Original.]

This hole is commonly known as the egg tube. When the boring and egg-laying is in operation, the locust exudes a white frothy fluid, which, being of a sebific or oily nature, lines and caps the tube with an impervious covering, thus protecting the eggs against insect enemies, fungi, and excessive moisture. From 20 to 30 eggs are deposited in each tube, each locust being capable of laying up to 100 eggs. The eggs are laid during October-November. Owing to the dry summer which follows in those areas the eggs do not hatch until the following July, a period of 8½ months. The hoppers, when hatching, can be seen pouring out of the egg-tubes one after the other. When they reach the surface they are still encumbered with a delicate film. They remain quiet for a short period until the sun dries and cracks the film, from which they escape and at once have full use of their limbs, readily hopping about. Owing to the fact that the locusts are irregularly laying

over a period of several weeks, the young hoppers issue in what might be termed relays. The main or plague swarm, however, emerge within a week or ten days.



Section of soil showing uncapped Locust Egg
Pods from which young have issued.

[Original.]

The more belated or minor swarms are too late to cause serious injury to crops or grass, but may cause damage to fruit trees, vines, etc.

The locust displays the gregarious habit from the time they hatch until death. The females when laying concentrate at certain areas and there lay their masses of eggs. It is a very important point, in the control of this pest, to observe and definitely mark the egg laying grounds with the view of breaking up such areas by ploughing or harrowing to a depth of 2 inches, for thus the egg tubes are broken, exposing the eggs to the elements, birds, and insect enemies.



Pre-winged hopper stage.

[Original.]

This work should be done as soon after egg laying as possible, before the ground becomes too hard. The earlier it is done the longer the eggs are exposed to the desiccating powers of the summer sun.

The locust after hatching from the egg goes through a series of five moults, finally appearing after the fifth moult as the winged adult. The hopper or pre-winged stage occupies about two months. The adult locust has its fore or front pair of wings of a light brown colour mottled and splashed with darker brown and clouded at the tips. The hind pair are transparent and clouded at the apex. The general colour of the insect is amber brown and the legs marked with spots or bands of chocolate brown. The antennæ or feelers on the head are short, in contradistinction to the long thread-like antennæ of many grasshoppers.



Adult or full-grown Locust

[Original]

The female locust measures $1\frac{1}{2}$ inches from head to tip of folded wings and from wing tip to wing tip $1\frac{1}{2}$ to $1\frac{3}{4}$ inches. The males are much like the females, but smaller.

The total life history in this State is as follows:-

Egg stage $8\frac{1}{2}$ months, hopper stage 2 months, winged stage 6 weeks.

CONTROL.

First and foremost, it is desirable to refrain from ring-barking forest country in locust areas years before the land can be brought under cultivation, as such ungrassed, sun-exposed land is a happy breeding ground for locusts.

Locate the egg-laying grounds and, as stated before, break up to a depth of two inches as soon as possible after eggs have been laid. The act of destroying the eggs in this way would, in itself, if systematically and co-operatively undertaken, be the cheapest, easiest, and most effective measure of locust control.

Unfortunately, the average man is prone to take the line of least resistance and action is generally deferred until disaster is threatened. This particularly applies in our attitude towards insect pests. The failure to attack the pest during its most vulnerable period often means considerably added costs and poorer results.

When a field of grain exists next to one known to be infested by young hoppers, it will often be an advantage to plough a strip between the two to act as a barrier. This will retard the advance of the insects for several days, and if a deep

wide furrow is made on the side from which the insects are advancing, this will temporarily entrap them and provide a convenient situation for killing them with poison bait.

If action of a preventive nature has not been taken, or has not proved effective, there is still much that can be done before the hoppers become winged. In previous outbreaks, the Entomological Branch of the Department of Agriculture, with the assistance of reliable farmers, carried out a series of field experiments consisting of trials with poisons, sprays, baits and dusts.

It is not necessary to detail these experiments, but it is desired to refer only to those trials which gave positive results. It was definitely demonstrated that the hoppers could readily be destroyed by spraying with a poisonous spray which acted both as a contact and internal killer. This was brought about by the fact that the poison was absorbed through the skin and breathing spiracles of the insect and also by the eating of the poisoned foliage.

The formula recommended for this purpose is 1 lb. of arsenite of soda, 2 lbs. of molasses, 16 gallons of water. This is sprayed over the hoppers, weeds and grass, resulting in the death of myriads of the young locusts. There is one definite drawback to the use of this spray in crop, in that it badly scorches the foliage, but when the scorching does not matter it can be used with excellent results. From 70 to 80 gallons of the spray is used per acre. Cattle or sheep should be kept off an area so treated for at least two weeks.

Poison baits were also experimented with; that giving the best results and recommended is composed of 1 lb. of arsenite of soda, 30 lbs. of bran, 4 lbs. of molasses or treacle, 3½ gallons of water. The arsenite of soda is dissolved in hot water, likewise the molasses. Both are allowed to cool before being added to the balance of water, making in all 3½ gallons of liquid. This is then added to the bran until it forms a crumbly moist mash. It is important not to make the mixture too wet. If Paris green is the poison used, mix 1 lb. with 30 lbs. of bran in the dry state, afterwards mixing with the molasses and water to the required crumbly consistency. Arsenite of soda is recommended because it is cheaper and more toxic to the locust.

Avoid mixing the bait with the hands, particularly if any cut or wound is present. The poison bait should be broadcast during the first feeding of the locusts. These insects fast all night and are not stimulated to feed until after sunrise, when the temperature of the air reaches 68 to 80 degrees. This is usually between 8 and 10 in the morning. The bait should not be put out when the temperature is below 68 or above 90 degrees, or during cloudy, windy or inclement weather. A still, bright morning is the best condition for baiting.

The hoppers after their night's fast are eager to feed, and after being warmed up by the sun they readily take the poison bait when distributed amongst them. Locusts do not die immediately they have eaten the bait. The poison may require 24 hours or even longer to become fully effective. It usually makes them sick within a few hours, however, and they do little further damage after having eaten a fatal dose.

The prepared mash should be thinly and evenly scattered over an infested field at the rate of 15 to 20 lbs. dry weight per acre, according to the number of locusts present. Every precaution should be taken to see that the bait falls apart into flakes.

Casting it into the wind with a snap of the wrist will help to accomplish this. If dealing with large quantities of bait, it can be distributed from the rear of a wagon or truck.

In the recent plagues experienced in the Eastern States a rather novel method, which has been proved definitely successful in destroying vast numbers of locusts, particularly in the hopper stage, has been evolved. In localities where sheep are available, a flock is driven over the ground where the young hoppers are concentrated, and by the action of their close treading the majority of the hoppers in their path are destroyed. Burning off, when safe, will destroy large numbers. The use of a roller where possible is advised.

Finally, let me impress upon all growers the great need for the co-operative poisoning of locusts, regardless of where they are found. A well planned campaign, started early and pushed to completion before the locusts are winged, will in most cases prevent serious crop losses; but if action is delayed in order to see what is going to happen, or until the pest is doing serious damage and on the wing flying from one field to another, failure is certain.

It is very important to remember that great and serious damage has been caused to pastures, crops and fruits in the Eastern States by the same species of locust as is herein referred to. It therefore behoves all interested to give serious consideration to the locust problem and take the necessary preventive and remedial measures before the pest appears in overwhelming plague form.

AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—Albany, A. C. Vaughan; Bridgetown, A. Flintoff; Bunbury, M. Cullity; Denmark, V. Cardon; Geraldton, G. L. Throssell, Government Buildings; Gosnells, R. C. Owen; Harvey, D. L. Breen (Fruit) and C. Giles (Dairying); Katanning, A. S. Wild; Manjimup, J. Ireland; Mundaring, V. Cahill; Northam, F. L. Shier; Northcliffe, A. Sharp; Vasse, J. M. Nelson.

STALLION REGISTER, 1934-35.

REGISTRATIONS PRIOR TO 21ST NOVEMBER, 1934.

*NOTE.—Age in years: A. aged; D. draught; Ar. arab; T. thoroughbred;
Tr. trotter; P. pony.

Name.	*Age and Class.	Owner and Address.
Admiral Fyvie	A.D.	C. E. Potts, Pingelly
Ahitana Bold	8 D.	R. Snow, Wickopin
Ahitana Admiral	A.D.	G. Hatwell, Dowerin
Allandale Duplicate	4 D.	R. Carroll & Sons, York
Allendale Thunderbolt	6 D.	A. Cleland, Perenjori
Altar Star Prince	6 D.	F. W. Evans, East Kondut
Anchor	A.Ar.	A. A. Toll, Wagin
Anama Renown	7 D.	A. Sanders, Dowerin
Annandale Baron	3 D.	J. Carruthers, Lake Grace
Armada	A.D.	M. S. Fisher, Lomos
Auchen Bloom	3 D.	G. W. C. Ward, Harris Smith
Auchen Pride	4 D.	J. Fitton, Moulinning
Banker's Pride	7 D.	F. C. Simpson, Pantapin
Barney	7 D.	A. Low & Sons, Kellerberrin
Baron Banchong	5 D.	P. Strange, Yarding
Baron	7 D.	H. Johnston & Sons, Balkuling
Baron Brachbank	5 D.	J. Kay, Baander
Baron Brayton	A.D.	J. Carr, Beverley
Baron Breastknott	A.D.	F. W. Gibbs, Dinninup
Baron Calcedon	8 D.	W. Johnston, Billaricay
Baron Clyde	5 D.	J. Knox, Yealering
Baron Dale	A.D.	A. W. Wilkins, Durakin
Baron Glen	7 D.	G. A. Howlett, Karlgarn
Baron Griff	3 D.	M. W. Hodgson, Dowerin
Baron Hillgrove	5 D.	C. Smith & Sons, Yarding
Baron Hillside	5 D.	R. Gault, Greenhills
Baron Lin	A.D.	M. A. Wickham, Yarloop
Baron's Prince	A.D.	E. B. Metcalf, Dowerin
Baron's Sovereign	A.D.	S. C. Gill, Kulyalling
Baron's Stamp	A.D.	R. Our, Newdegate
Baron Ward	A.D.	J. N. Ford, Narembeen
Bencubbin Bill	5 D.	H. M. & M. Growden, Quairading
Benowrie Crest	3 D.	L. M. Craig, York
Black Baron	6 D.	H. V. Boundy, Babakin
Black Prince	4 D.	Franklin & Sons, Wyola
Bloomfield Flashlock	A.D.	B. M. Connor, Toodyay
Bloomfield Sensation	5 D.	L. R. Blight, Mukinbudin
Baron Victor	3 D.	M. Lucas, Beverley
Beau Brummel	A. Tr.	R. English & Son, Wickopin
Beau Valley	2 D.	G. J. Bostock, Pingelly
Bold Everest	5 D.	A. H. Young, Aldersyde
Bold Jack	7 D.	Caffell & Piney, Tammin
Bold Major	5 D.	C. W. Heal, Quairading
Bonnie Crystal	4 D.	P. Rose, Burekup
Bonnie Vale	A.D.	R. Bungey, Borden
Bonny	A.D.	C. A. Richter, Wickopin
Boondilla Vice Roy	8 D.	H. R. Argent, Lake Grace
Border Ensign	A.D.	W. J. Faulkner, Kukerin
Boxer	4 D.	J. Lloyd, Lake Biddy
Boxer	6 D.	V. H. Francis Lane, Three Springs
Bradman	5 D.	A. F. H. Muir, Manjimup
Brilliant Day	A.D.	Yarragadee-Nalbarra Pastoral Co., Mingene
Brilliant Starlight	6 T.	C. Draper, Duranillin

STALLION REGISTER, 1934-35—continued.

Name.	*Age and Class.	Owner and Address.
Brilliant Town	4 T.	Yarragadee-Nalbarra Pastoral Co., Mingenev
Broadview Winalot	6 D.	R. Carroll & Sons, York
Bruce	A.D.	T. Johnson, Yandanooka
Bruce	6 D.	Beswick Bros., Yealering
Bruce Leader	6 D.	A. W. Douglas, Woodanilling
Buchlyvie Bute	A.D.	R. Carroll & Sons, York.
Bulagin Major	6 D.	J. E. Peters, Wyalkatchem
Bullara Dale	6 D.	H. G. Johnston, Dangin
Burnside Viceroy	2 D.	R. Kirkham, Yarloop
Caledonia	5 D.	R. Carroll & Sons, York
Carlot	4 T.	Darlot Bros., Mingenev
Carngham Baron Jim	A.D.	McLarty Bros., Pinjarra
Carngham Bold	8 D.	R. James, Carnamah
Carngham Flash Dignity	4 D.	J. A. Stevens, Kellerberrin
Castlemaine	6 D.	J. Spackman, Wickopin
Castle Ray	5 D.	C. L. Perry, Darkan
Claphamdale	6 D.	F. W. Wright & Co., Dalwallinu
Clifton Flashdale	6 D.	J. Harrod, Kununoppin
Clyde	5 D.	S. L. E. Lange, Popanyinning
Colingrove Baron	4 D.	Murrumb Pastoral Co., Goomalling
Con of Buchlyrie	A.D.	M. J. Bennett, Lake Grace
Coorara Robin	4 D.	P. E. Forrester, Southern Cross
Coorara Flash Ronald	3 D.	P. Falconer, Trayning
Craig Noble	5 D.	A. T. Zwaar, Merredin
Craigie Emblem	5 D.	L. H. Lawrence, Northam
Craigwillie of Cooring	A.D.	A. J. Magee, Kulin
Cramphorne Lothian Craig	5 D.	W. A. McAlpine, Latham
Culloden	4 D.	J. Watkins, Wagin
Dalmeny Footstep	3 D.	A. Della, Wannamal
Dalmeny Middlerigg	3 D.	M. G. Murray, Bowgada
Dalmeny Renown	8 D.	W. Jones, Walkaway
Daliak Bute	2 D.	C. & A. Thorn, York
Don	4 D.	J. Dixon, Kellerberrin
Don McDonald	A.D.	W. Stewart, Pithara
Doon Aucheneraig	4 D.	J. H. Stone, Dangin
Doon Auchan Gift	2 D.	E. Bushalla, Narrogin
Doon Loch	3 D.	G. H. White, Dinninup
Dora's Dunure	A.D.	Edgar Bros., New Norcia
Douglas Cobham	8 D.	W. Fraser, Dowerin
Duke	2 D.	E. W. Whittington, Brookton
Dunlop	3 D.	G. Goodall, Kojonup
Dunure Valley	4 D.	G. Pense, Wickopin
Earlstone	A.D.	R. T. Jenkins, Wagerup
Eastern Hero	4 D.	R. P. Wardle, Moora
Edenhope's Beauty Masterstroke	2 D.	J. H. Ferrier, Wickopin
Egyptian Idol	A.T.	F. B. Wittenoom, Toodyay
Enfield Monarch	4 D.	C. Smith & Sons, Yarding
Erindale Glengyle	4 D.	E. V. Brockman, Nannup
Eudamatch	A.T.	F. T. Carter, Tammin.
Fairfield Scottish Banker	6 D.	A. McD. Sargent, East Katanning.
Ferndale Briton	5 D.	A. J. Hill, Beverley
Fitregas	A.T.	J. B. Newbicum, via Boyup Brook
Flaming Star	6 T.	R. P. Bryant, Quairading
Flash Mac	8 D.	H. W. Treloar, Boyup Brook
Flash Willie	3 D.	H. P. Jolly, Nungarin

STALLION REGISTER, 1934-35—continued.

Name.	*Age and Class.	Owner and Address.
Gallantry	A.D.	C. Lawler, Wongamine
Gay Baron	4 D.	Hon. E. Rose, Bunbury
Gay Boy	3 D.	H. Weaver, Gabbin
Geordie	A.D.	R. J. McCarthy, Esperance
Glencoe Victor	3 D.	C. W. Bateman, Beverley
Glen Varloch	4 D.	C. Walker, Kokerin
Golden Image	4 D.	W. F. Penny, Greenhills
Golden Wheat	8 T.	A. E. Cockram, Belmont
Grand Newton	A.D.	D. Johnston, Greenhills
Great Scott	3 D.	W. Linto, York
Gumpark Favourite	8 D.	H. G. Bolt, Woodanilling
Hagley MacGregor	4 D.	Preston & Ryan, Tammin
Heather Lad	2 D.	D. Walker, Balingup
Hillgrove King George	4 D.	E. David, Kellerberrin
Homebush Chester	6 D.	R. W. Moodie, Westonla
Homebush Sampson	5 D.	J. Rogie, Pingelly
Howqua Dale	6 D.	J. O'Toole, Gnowangerup
Harold's Pride	3 D.	C. D. Williams, Boodarockin
Ideal Footstep	8 D.	A. Jones, Dowerin
Inverell Footprint	2 D.	A. Jones, Dowerin
Inverell Freestep	2 D.	A. Jones, Dowerin
Inverell Jock	2 D.	A. Jones, Dowerin
Inverell Lightstep	2 D.	A. Jones, Dowerin
Inverell Satisfaction	4 D.	H. F. Cook, Tammin
Jack	4 D.	H. Hatfield, Kellerberrin
Kathleen Vale Style	4 D.	W. J. Pethick, Winchester
Kayanaba Don	3 D.	H. P. Halligan, New Norcia
Kayanaba Pilot	3 D.	T. W. Ward, Ballaying
King Edward	A.D.	W. Sherwood, Wyalkatchem
Koojan Earl	A.D.	F. Packham, Tammin
Koojan Norval	A.D.	— French, French's Siding
Kayanaba Duke	4 D.	C. J. Roberts, Dandaragan
Laddie	3 D.	H. Beard, Jennapullen
La Fayette	A.Tr.	D. Stevenson, Moulyinning
Laddie	A.D.	F. Bussell Vines, Busselton.
Leurgan Ben Holton	4 D.	T. Wilding, Mokine
Lord Banker	6 D.	A. W. Hewton & Sons, Minnivale
Lakeside Bold Bute	8 D.	Shadbolt Bros., Mukinbudin
Longernong Dignity	6 D.	E. Williams, Northampton
Lord Charmer	7 D.	N. F. West, Wagin
Lord Pontiac	3 D.	J. A. Seaman, Greenhills
Lord Roseberry	8 D.	W. Morgan, Wagin
Lothian Hero	3 D.	J. C. Summers, Capel
Lothian Prince	6 D.	G. S. Dayman, Emu Hill
Londoun Stamp II.	6 D.	Growden Gros., Nangeenan
Lucky	4 D.	W. J. Drage, Mt. Barker
Lyndhurst	7 D.	E. A. Ebsary, Wickepin
Lyon	3 D.	J. Longuran, Bindi Bindi
Mac	6 D.	H. W. Fitt, Narrogin
Mack	7 D.	G. E. Robins & Co., Babakin
Major	3 D.	L. R. Martin, Williams
Major Douglas	4 D.	J. Piggin, Trayning
Major Hillside	6 D.	E. K. Brown, Dumbleyung
Major Valley	A.D.	H. A. Lupton, West Beverley
Marsonius II.	4 D.	Burgin & Yeomans, Wadderin Hill
Master Celtic	A.Tr.	H. Patroni, Donnybrook

STALLION REGISTER, 1934-35—continued.

Name.	*Age and Class.	Owner and Address.
Max	3 D.	J. Everitt, Pantapin
Mayica Boy	3 D.	A. Jones, Dowerin
Mendie	7 T.	Benedictine Community, New Norcia
Mona Park Baron	8 D.	Wiese Bros., Highbury
Moorlands Captain	7 D.	A. V. Moore, Doodlakine
Mussolini	6 D.	E. Ludeman, Wattening
Nariel Banker	5 D.	L. J. Stacey, Quairading
Native Prince	4 D.	C. Scott, Bullfinch
Neumylde	A.T.	Penn Bros., Northampton
Newbold Enterprise	7 D.	Craike Bros., Trayning
Newfields Ambition	6 D.	C. G. & A. E. Nicholas, Gnowangerup
Newfields Sensation	4 D.	E. P. Young, Kondinin
Night Douglas	6 D.	W. J. Glen, Rivervale
Noble Lee	4 D.	W. J. Neill, Boyanup
Nonsuch Style	A.D.	T. Pauley, Wickepin
Nonsuch Style	7 D.	M. H. Erhardt, Dowerin
Oaklyn Refiner	4 D.	V. G. Rennie, Gingin
Olympian	5 T.	F. A. Farquhar, Gingin
Penryn Leader	4 D.	S. L. Folland, Coorow
Penryn Leading Dale	8 D.	E. J. Sinclair, Esperance
Perfect Hero	2 D.	R. J. Parnell, Gnowangerup
Peter Stretta	A.Tr.	Dr. A. Jewett, Perth
Peter of Triagen	6 D.	W. Potthoff, Kondinin
Peter Voyager	8 Tr.	W. Pratt, Belka
Pilot	3 D.	H. W. Langley, Brookton
Pride	7 D.	W. Mullan, Harrismith
Prince Aubry	4 D.	W. A. Wiseman, Kulja
Prince Belmont	5 Tr.	A. J. Reither, Pingelly
Prince Bold	5 D.	H. W. England, Bowgada
Prince Derby	A.Tr.	R. Carroll & Sons, York
Prince Douglas	4 D.	A. Stewart, Dowerin
Prince George	5 D.	C. H. Saw, Bow River
Prince Gilikin	4 D.	A. C. Carter, Williams
Prince Loman	4 D.	G. Fontanini, Manjimup
Prince Paladin	3 D.	S. King, Dowerin
Prince Robert	5 D.	L. Brissenden, Muntadgin
Prince Roland	3 D.	H. McCormack, Gingin
Prince Roy	A.D.	D. Hehir, Yandanooka
Prudent Beggar	A.T.	H. Evans, Perth
Punch	5 D.	T. G. & J. Maughan, Nukarni
Punch	4 D.	W. Lines, Ballidu
Punch	A.D.	F. Bishop, Three Springs
Rab	6 P.	J. Spiers, Wanneroo
Robin	A.D.	H. Hamersley, Wagin
Rob Roy	6 D.	E. A. Bates, Welbungin
Rosecombe	4 D.	F. Clifton & Son, Gwambygin
Roselock	3 D.	T. H. Leake, Kellerberrin
Rosemont	A.D.	W. K. Miller, Donnybrook
Rosalyn Douglas Viceroy	A.D.	Becker Bros., Wagin
Rothersey Prince Craig	3 D.	W. G. Argent, Kulin
Rowdy	4 D.	C. Eyden, Highbury
Royal Appotenic	3 D.	A. J. Young, Kondinin
Royal Main	A.D.	W. H. Biggin, Kondinin
Royal Prince	3 D.	W. A. T. Sargent, Carnamah
Royal Star	A.D.	G. Irving, Cranbrook

STALLION REGISTER, 1934-35—continued.

Name.	*Age and Class.	Owner and Address.
Secheyvilleure Librarian	6 D.	J. Christie, York
Scotch Willie II.	4 D.	J. H. Price, Narembcen
Scottish Lad	3 D.	Mt. Barker Estate, Mt. Barker
Sea Crest	A.T.	L. W. Viveash, Northam
Sedalia Douglas	5 D.	T. G. McGellin, Belka
Silver Bold	5 D.	Wilhelm & Sons, Woodanilling
Silver Prince	3 D.	C. A. Sweeting, Tammin
Simpson's Earl	A.D.	W. C. Simpson, Round Hill
Sir Charles	3 D.	A. D. Jones, Latham
Sir James	A.D.	E. Vanzetti, Marchagve
Sir Walter Raleigh	5 D.	W. J. Bowers, Gingin
Some Scotch	7 D.	R. J. M. Fairclough, East Katanning
Spats	7 Tr.	Cowcher Bros., Williams *
Sproxtton	6 D.	Raffan Bros., Winchester
Squire Douglas	5 D.	B. Maughan, Walgoolan
Star	4 D.	D. Gunn & Son, Kellerberrin
Stockfield Satisfaction	3 D.	B. Maughan, Walgoolan
Sunday Sun	4 D.	A. Wilkinson, Aldersyde
Sunnylands Craig Fashion	5 D.	J. M. Young, Gwambygine
Sunnyside Alick	7 D.	Page Bros., West Pingelly
Tandarra Baron	7 D.	G. Ferrier, Mingenew
Taunton Robin Adair	4 D.	S. O. Argent, Lake Grace
Tinedale Prince	3 D.	H. Sainsbury, Ballidu
Tipperary	5 D.	R. H. Fulwood, Cunderdin
Trooper	6 D.	G. J. Butterworth, Katanning
Tynedale Kenwyn Again	3 D.	H. J. Wise, Katanning
United Scotch	5 D.	G. Moir, Borden
Valerano	A.T.	Benedictine Community, New Norcia
Valetta Ramon	4 D.	H. W. Creek, Corrigin
Victoria Shamrock	6 D.	S. B. Rudduck, Coorow
Victory Star	4 D.	G. W. Smith, Corrigin
Wallad	5 A.	C. C. Readhead, Walkaway
War Dance II.	5 D.	P. Briotti, Koorda
War Dance III.	3 D.	Ferguson Bros., Koorda
War Dolan... ..	6 D.	M. E. Millar, Mandiga
War General	6 D.	C. A. Sweeting, Tammin
Wattle Grove Gaylad	7 D.	A. M. Day, Burracoppin
Wattle Valley Bold Boy	3 D.	E. A. Ebsary, Wickepin
Wattle Valley Rosemont Again	6 D.	J. Franks, Lake Grace
Wattle Valley Stamp	A.D.	H. G. Ebsary, Wickepin
Wee Laddie	5 D.	G. Petchell, Williams
Wendourie Auchenflower	4 D.	P. J. Collins, Tambellup.
Werndew Flashlight	6 D.	J. Carruthers, Lake Grace
Werndew Squire	3 D.	H. W. Biglin, Kondinin
Werrap Pride	3 D.	L. C. Cusbert, Bruce Rock
West Wimmera	6 D.	W. G. Hallam, Red Lake
Widgie	3 D.	G. L. Weaver, Beverley
Widgiwa Pilot	A.D.	R. Ditchburn & Sons, Kukerin
Widgiwa Pete	2 D.	W. T. Hobbs, Beverley
Wimmera Cavalier	3 D.	Benedictine Community, New Norcia
Woolamia Mark	2 D.	J. & H. B. Rinaldi, Kalannie
Woolie	A.D.	J. Thomson, Donnybrook
Wrayton Mark	2 D.	J. E. Bates, Boddington
Yadlock	2 T.	D. C. Pearce, Kojonup
Yodelist	A.T.	H. H. Roberts, Capel

* NOTE.—Age in years—A. Aged ; D. Draught ; Ar. Arab ; T. Thoroughbred ; Tr. Trotter ; P. Pony.

OLIVE YOLKS.

G. D. SHAW, Poultry Adviser, Department of Agriculture.

"Olive" Yolk or "Olive Coloured" Yolk, which has been prevalent and increasing in Western Australia for the last six years, is causing considerable concern in the poultry industry.

Literature from the world's experimental stations states the cause as the feeding of greens containing pigment.

While admitting that a yolk can be coloured by feeding a diet rich in pigment, the writer considers there are two distinct "olive" yolks, classified into:—

1. "Olive coloured" yolk.
2. "Olive yolk" or diseased yolk.

The first is caused by feeding excessively on a green diet rich in pigment, and when the egg is laid it is coloured and "candles" distinctly olive.

Eggs of the second class when laid are normal in colour, but when kept in normal spring or summer temperatures over a period of four to six weeks gradually develop a yolk which is definitely green, with a thickening, showing corrugations over the surface. These eggs when seen under the candling immediately after being laid are normal, but when five days old show the same colour as an "olive coloured" yolk.

In order to differentiate between an "olive coloured" yolk and an "olive yolk" or diseased yolk, on a candling floor, it is necessary to keep the eggs about 14 days; an "olive coloured" yolk does not change colour, and can then be separated from an "olive yolk" because the latter has developed a deeper colour.

How to tell an "Olive Yolk" (diseased) or "Olive Coloured" Yolk under the lights.

When looking through an egg the normal yolk shows no tint at all, but with a diseased yolk one sees just the faint semblance of grey tint incorporated. This tint is similar to one obtained if a drop of black ink had been stirred into the yolk. As the egg ages, the grey deepens until the orange of the yolk has been replaced by a deep grey colour. When the grey predominates over the orange colour, the egg is found to be unsightly on breaking.

The "olive coloured" yolk is laid "olive," and is easily discerned as a grey yolk, but when broken is normal except for a very light greenish tint in the yolk and *white*.

At the normal period of marketing, between four to seven days, it is impossible to separate the "olive yolk" from the "olive coloured" yolk, owing to the progress made by the diseased egg.

Lines of Information.

During the export season of 1933, the writer was in a position to observe this phenomena closely. It was found that the trouble in most country districts gave support to excessive green feed pigment theory, but it was noticed to occur on a farm owned by the writer, at a time when, owing to lack of facilities at the moment, no green feed was being fed.

This led to a new line of thought and investigation.

Knowing the condition of the flock when the farm was purchased, further symptoms were sought, and trap-nesting and culling experiments were undertaken. The "olive yolk" laying birds—obviously weak-constituted specimens—were culled, thereby eliminating "olive yolk" from the market returns.

Several farmers in the country, who were marketing "olive yolks," were advised to tone up their stock, and this had a marked effect, but the result was not conclusive, because the season of "olive yolks" passed before the treatment could be continued. Also it was found more prevalent in eggs marketed once a week than in those lines marketed more frequently.

Experiments conducted to ascertain the result on Condition of the Egg after Candling.

An excellent candler (one who could discern the "olive yolk" in its infancy) was requested to report all lines showing that defect. These eggs were divided into four lots, two being placed in cool store, and two left out under normal conditions.

Cool Store Section.—Did not develop, but were held in suspense.

Normal Section.—These eggs in some cases developed to a dark green, and in others stayed the condition as when candled.

It was then decided to ascertain the position when kept in cool store for periods of three months and six months. Four cases, each containing 25 dozen eggs, were placed in cool store at 35deg. in October, 1933, and examined periodically. No change was noted, and, on 11th May, 1934, the cases were withdrawn and candled by myself. No change had taken place; the colour had not deepened.

Two dozen of these eggs were then taken to the Department of Agriculture and left in normal conditions, with the result that part of the two dozen developed to a dark green as before mentioned.

Effect on Whites of Eggs showing "Olive Yolk."

Ten lbs. of "whites" were made from eggs showing either "olive coloured" yolk or "olive yolk." Ten lbs. of whites were made from normal yolk. Both lots were placed in cool store and after three months taken out and treated in a manner similar to that required by a pastrycook, i.e., thawed, and a quantity taken out, the remainder again frozen; thawed again, and again frozen until both lots became sour. No difference in quality could be found, which leads one to the conclusion that the whites are not affected by the disease of the yolk.

Experiments with Pulp.

40 lbs. pulp from normal yolks as a control, and

40 lbs. pulp from "olive yolk" or "olive coloured yolk."

These were treated as were the whites, the effect being that the "olive coloured" pulp went a blackish colour, while the normal pulp went sour, the sourness in both cases being put down to the fact that the continued application of thawing caused fermentation.

Other Results.

Some eggs which have been candled for local consumption have (in the retailers' shops) gone bad, and on investigation have proved to be the diseased "olive yolk" (of course we are not considering the dead germ of a fertile egg).

In 1933 seven chicks were hatched from "olive yolks" marketed from the country, but unfortunately in April 1934 heavy rain drowned them. It was intended to observe their laying and condition when laying.

Last September (1934), eggs sold after being candled developed to the green stage three weeks later.

General.

These defects occur during the period of excellent green feed growth, *i.e.*, in the spring, but it should also be understood that the weak constituted bird also lays at this period.

The disease in the egg also disappears as the grass dies away, but the weak constituted layer also stops laying at this time.

It appears that the two are combined in season, and this makes it extremely hard to continue with experiments. It is also noticed that eggs from the farms of men who "cull" heavily do not contain the "olive yolk" and that those who do not "cull," *i.e.*, the newcomers to the industry, contain high proportions; as high as 80 per cent. has been seen. I have been called to "cull out" farms, and when cleaned up the owners have had no "olive yolk" in their market consignments until a further weakness has developed in the flock.

The results have led to a belief that the cause of "olive yolk" is inherent in all birds, but can only develop in a weak constituted one, and as a farmer should not tolerate that class of bird on his farm, it should eventually be kept in check and entirely eliminated.

It must be understood that although the heavily "culled" farm does not market the "olive yolk," it may be present in the flock, but is kept in control.

POULTRY FARMING FOR THE BEGINNER.

(Continued.)

G. D. SHAW.

Poultry Adviser, Department of Agriculture.

Pullets are in their best laying condition when they are well grown, completely feathered, and in the best of health. At this stage they should handle "heavy" with the feathers giving a feeling of "tightness" to the body. We have been handling our stock now for five months and should recognise body, size, shape and stamina; without all these the bird is sure to break down sooner or later.

When handling a good bird, no matter of what breed, look for body proportion. A well proportioned bird is one that measures in proportion of 1 in depth, 1 across the back, and $1\frac{1}{2}$ along the back from where the neck joins the body to just in front of the tail. Any definite variation from these figures will place a bird out of proportion. Length, breadth and depth give us a well proportioned bird which can be well balanced and have a good capacity for producing eggs.

The pullets at this stage should be carrying a little fat at the abdomen, not too much, but certainly easily discernible when handled. In handling, the good bold eye and intelligent face must not be forgotten.

At this stage, care should be exercised in the methods of feeding. It is at times advocated that when the birds start laying they should be placed on a laying mash, and while in agreement with this statement, the meaning of a layer's mash must be understood.

Up to this stage feeding has been for growth in order to give the pullets a chance of carrying on through a laying season without check, and here the farmer is advised to consider whether all the eggs are to be obtained during the first year or over a longer period.

It has already been mentioned that the pullet is born into the world with the one object of reproducing her species, and we must cultivate that objective. It must not be thought that eggs mean chicks. More often than not, it means no chicks. The pullet must be nursed for twelve months. It is not reasonable to force for egg production in her first year and then expect plenty of strong, healthy chickens during her second season. If a pullet is fed for stamina and growth, she will give of her best during both years.

The practice to-day is to force the pullet to take a rest after her first laying season before asking her to produce eggs which will produce hardy, easily reared chicks. To follow that practice, those pullets must not be placed on a layer's ration, but still continue to be fed for growth—the eggs will come naturally.

A layer's ration is one which is fed when the advisability of disposing of the birds at the moment they cease to produce is being considered, and its use is to force egg production during the birds' last season on the farm.

Keep the pullets on a grower's ration.

Milk.

The value of milk has not been considered up to this point.

Milk—separated, skim, or dried buttermilk—is a most valuable addition to all poultry feeding. The chicks thrive on it and the growing stock also. Most farmers have their own household cow, and it is advisable to feed all the milk one can afford to the young stock. In fact, if skim or separated milk is not obtainable, dried buttermilk is easily procured and is a valuable food.

The baby chicks can be left to consume as much skim or separated milk as they can, but care should be taken that it is fed either fresh only or sour only. If fresh is alternated with sour, bowel troubles can be anticipated, because the young stock are not strong enough to manage the change.

A 5 per cent. addition of dried buttermilk is the proportion required for stock.

Until the butterfats have been separated, do not give the milk under any consideration.

A word of warning is necessary at this stage. It has been considered that the protein content of the milk can take the place of the protein content of the meatmeal. It can, within limits, but it must not be forgotten that separated and skim milk contain a proportion of water and as such we must be careful that 10 lbs. of meatmeal are not replaced with 10 lbs. of milk. Consider the solid content only and when reducing the meatmeal do so only in proportion to the solid content of the milk. Experience encourages the belief that the addition of milk to a ration without reducing the other proteins is not harmful. In fact, it is an advantage, overcoming the danger of feeding less protein than would otherwise be the case, when the solid content of the milk is not known.

When a pullet starts to lay, it has a double function to perform; that of manufacturing eggs and at the same time replacing wasted tissue. The strain must be enormous and we must be prepared to meet that strain by careful management.

This is where handling becomes so necessary, and what better procedure than by handling during the process of trapnesting?

Trapnests.

A trapnest is a nest which has a front to it so arranged that on the bird entering the nest the front is released, thereby imprisoning the bird until the attendant has registered the number and egg.

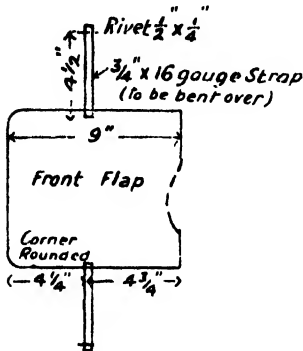


FIG 1

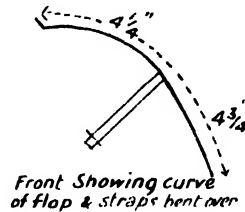


FIG 2

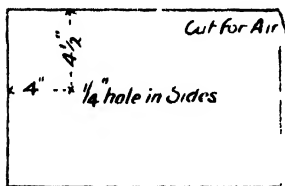


FIG 4

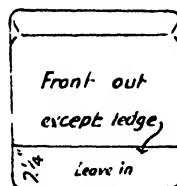


FIG 3

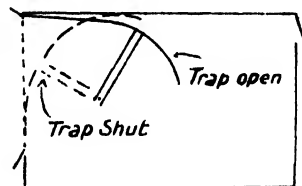


FIG 5

One sheet of 36in. x 22in. P.G. iron, cut into pieces 9in. x 8in., will make 36 nest flaps for kerosene tins (Fig. 1). Two pieces, each 5in. x 3/4in., 16 gauge galvanised straps are required for arms; two galvanised rivets for pins, 1/2in. x 1/4in., at end of arms; two smaller rivets to join arms to flap. The tin is cut out in front (Fig. 3), leaving ledge 2 1/4in. in tin, and cut at the top rear for ventilation. Two holes, 3/4in. in diameter, are punched in the sides near the front 4 1/2in. from top and 4in. from front (where the 1/2in. x 3/4in. rivets turn) (Fig. 4). The arms are riveted to flaps and then bent downwards (Fig. 2). The natural spring in the arms allows pins to fit into holes in the sides without releasing. The flap is curved (Fig. 2) so that it swings clear of top of tin, at the same time not falling inwards. The rounded end (Fig. 1) is at the rear and the other end is cut out to lighten it. Outer end is turned outwards; this rests against top of tin when nest is open. The front is the important part. Measurements given are for front for kerosene tin. If other size boxes are used all measurements to be adjusted in proportion, i.e., if front of nest is 12in. x 12in., all measurements will be multiplied by four-thirds of those given.

A kerosene tin has been found satisfactory for both heavy and light breeds.

Each pullet has been branded with a red celluloid embossed or numbered brand. It will be noticed that the pullet on first entering the nest is extremely timid and will have a tendency to break the eggs in its struggles to obtain release. As the pullet will enter the nest days before the first egg is laid, the attendant has an opportunity of obtaining the bird's confidence. When releasing the bird, handle it gently, stroke it along the back, and then place it gently on the floor of the shed. (Do not drop it.) Stroke it again and then release. After three or four days the bird will be responding to the treatment, and the tendency to rush about the nest after laying is reduced.

The pullets, after a large egg or two, will settle down to steady production. The pullet which lays consistently with a break of one day in four or five is the one which should be cultivated.

Marketing.

It is of little use producing good-sized eggs if our system of marketing is at fault. The prevailing pack in Western Australia is the kerosene case, a size of package which can accommodate 25 dozen 2-ounce eggs.

There are two ways of forwarding eggs to market: -

- (a) In chaff.
- (b) In fillers.

Packing in chaff has been most popular in past years, but is being replaced by the filler method. Each has its advantages and disadvantages.

Chaff for packing eggs must be of the best quality. It is fatal to use mouldy or tainted chaff. The practice of producing good-quality eggs, then packing them in poor, mouldy chaff, causes untold losses to the producer. If your produce is good see that it reaches its destination in that good condition. A mouldy chaff or even one that has a faint taint imparts that taint to the eggs, and so lowers their quality. An alert buyer will not tolerate a tainted parcel of eggs, except at a low value.

Country producers should have no excuse for using other than good clean chaff. The metropolitan producer can also obtain good clean chaff either from the produce merchant or the flour mills.

Packing in fillers is a recent innovation in Western Australia. One can obtain fillers and flats for kerosene cases at nominal cost from the marketing agents. These are replaced in each consignment received and renewed when necessary. A small fee per case is charged for renewal.

Grades.—In Western Australia an Agricultural Products Act which, by its regulations, controls the marketing of eggs in shell, is in operation.

Its main provisions are:—

- (1) The top layer must be a fair sample of layers beneath;
- (2) The eggs must be graded for size and quality;
- (3) The case or package must have grower's name and address;
- (4) The eggs must be clean;
- (5) The grade of egg and number contained therein must be on the case or package.
- (6) The grades are, New Laid, Fresh, Cooking and Stale.
- (7) The sizes are:—Standard—not less than $1\frac{7}{8}$ ozs. in weight; pullet—less than $1\frac{7}{8}$ ozs. in weight.
- (8) Cool Store and/or preserved eggs must be individually stamped "chilled" or "preserved" with an approved stamp and an approved indelible ink.

Quality.

By "new laid" is meant an egg which reaches the marketing floor within seven days after the egg is laid.

A fresh egg is one under 14 days old.

A cooking egg is one between 14 and 21 days.

A stale egg is over 21 days old and in this grade are classed all eggs which have faults which cause them to be unfit for human consumption—this grade of egg is destroyed.

The necessity of collecting twice daily and forwarding to market at least twice weekly is therefore obvious.

In order to keep your quality in No. 1 grade, it is also necessary to look for and eliminate other possible faults. By collecting twice daily and wiping where necessary with a damp (not wet) cloth, any dirt is easily removed before the egg is permanently stained. The natural warmth contained in the egg is helpful in the drying process and eggs can be packed almost as soon as wiped.

It certainly develops a routine, and a routine is necessary where eggs are concerned. Nothing is more tedious than the work necessary to clean and pack the accumulation of two or three days' eggs.

Under quality must be discussed that abominable practice of having cock birds continually running with the hens. Nothing defeats quality more than the fertilised egg and nothing reduces consumption greater than the fertile egg gone bad.

It may be a controversial subject, but under present conditions it has been decided that the male bird is not necessary for maximum production of eggs.

The male is certainly necessary on a farm which intends to breed its yearly requirements of chicks, but at that period only should he be at liberty to mate. Keep the male away from the laying birds at all times, but more especially during the late spring and summer months.

In order to produce the chick, a uniform temperature of 103 degrees for a period of three weeks is necessary to incubate the chick. After a fertile egg is laid and providing the incubating temperature is not applied, the germ action is held in suspense.

Should the weather temperature be at 80-90 degrees consistently for 6 to 10 hours, the germ starts to develop and unless the incubating temperature of 103 degrees is reached and continued for three weeks, that germ dies and the egg will go bad.

This is what is happening in most of the consignments arriving on the market during the late spring and summer months, a happening which causes low prices for eggs from both country and metropolitan producers unless the consignments are marked "Guaranteed Infertile" or the producer is known to be a farmer who has his birds separated.

An infertile egg, because it does not contain life, never goes bad. It will certainly become watery, then break down, and eventually dry up, but never reaches the state of a putrid mess.

It is surprising how one bad egg in a consignment affects consumption. It is generally the bad egg which is first broken by the housewife and the remaining eleven are allowed to go bad through lack of use.

Keep the sexes apart.

If a strange nest is found do not take it for granted that the eggs contained therein are fresh. If the means are available candle them, if not, keep them for your own consumption.

A producer who can always be relied upon to market a good new laid infertile egg is the one whose eggs (no matter how bad the sale) are the first to be sold and then usually at a higher price than others.

Perseverance on the market with good eggs is necessary before a position in the buyers' confidence is attained. It is hard to get and when you do get it, keep it. A good name is easily lost, if bad practices are allowed to creep in.

When packing in chaff, place at least 2 inches of chaff in the bottom of the case. Pack the eggs inclining at an angle of 45 degrees and do not try to pack too closely. One must remember that those eggs must be handled again for resale to consumers and if any difficulty is experienced in unpacking, it generally means broken eggs with the usual condemnation of weak shells when really it is close packing. There should be at least some chaff between each egg and also between the egg and the side of the box.

When the layer is packed, gently vibrate the box to and fro then place a layer of chaff half an inch deep on the eggs and again vibrate them and then more chaff to fully cover the eggs. Continue with each layer in the same way until case is filled.

If eggs must travel any distance by rail or motor transport, never try to pack more than 20 dozen eggs in each kerosene case and always have a cushion of chaff covering the top layer of eggs.

Fillers.

When packing in fillers, it must be remembered that the buyer has little chance of examining any but those eggs on the top layer, and be careful to see that the layer exposed is a fair sample of all layers beneath. Here it might be mentioned trouble is found in the packing. Many packers *do not* put a thick cushion beneath the bottom layer. In most cases all one finds is a flat bearing on timber (and timber none too thick at that). When the eggs are dropped into the fillers, the contact with the bottom is such that in a lot of cases a cracked egg is the result.

Long eggs also have the habit of supporting the egg above them, but not before the uppermost egg has dented the shell of the long egg below. Long eggs should be placed in the corners or at the edges.

With a deep cushion under the bottom flat, by keeping out all long or "fat" eggs one can reduce cracks, but no effort should be made to pack 25 dozen in a kerosene case. The maximum then is 20 10/12ths dozen which is five layers of 4 2/12ths dozen each layer. This leaves a space for a deep cushion over the top layer.

Owing to the careless way in which eggs are placed in filler packs, the buyers are not too confident when purchasing eggs in those packs. A little more care in handling would help to gain the buyers' confidence and so enhance the price of the produce.

Faults in Eggs for Local Consumption.

When consigning eggs for local consumption they must be fresh, sound and clean. Troubles such as the fertile egg going bad, the blood spot and staleness are occurring.

Birds having accidents to the ovary or oviduct might continuously lay "blood spotted" eggs. Should this be brought to your notice, trapnests make it easy to eliminate the faults.

Thin shelled eggs are a trouble generally caused by a shortage of shell-forming material—shell grit or bonemeal—and can easily be overcome by additional bonemeal to the ration.

Because there is shell grit in abundance before the pullets, it cannot be guaranteed that the eggs are properly shelled and the addition of bonemeal may not overcome the trouble. It may be deeper seated than that. Perhaps the birds cannot use the grit and bonemeal given to them and only by a general toning up of the system can they function properly.

Where one or two birds only are laying thin shells, do not attempt to alter the ration, rather eliminate the birds. It is only when a *flock* shows a tendency for thin shells that it is necessary to treat generally.

Diseases.

Sickness may be expected during the next three months, and heat waves coupled with the cool changes will cause concern for the health of the flock. It is of little use waiting until disease is present, but every effort should be made to prevent what can be reasonably expected.

Vertigo, colds, catarrh, roup in all its forms, bronchitis, and pneumonia, are always present during changeable weather and must be seriously combated in the preventive stage.

A heat wave is generally followed by a cool change, and chills developing into colds, catarrh, roup, bronchitis and pneumonia may be expected. As a preventive, dose the drinking water with permanganate of potash (Condy's crystals) until it is a deep claret colour. Do this daily, at the same time covering the water with a thin film of kerosene. The kerosene will kill any germs left by an affected bird.

It is well known that a sick fowl always consumes a vast amount of water. Excessive body temperature necessitates this and our aim should be to keep that sick fowl from contaminating the drinking water partaken of by a bird in good health. Hence a water trough three (3) feet above the floor on the ledge containing the nests is recommended. Only a bird in good health can reach it and the sick bird is generally beneath looking upwards to where the water is located. It is then easily noticed and doctored early in the progress of its particular ailment.

Vertigo may be caused by hereditary influence, overfeeding, excessive heat or great excitement. It is common with birds kept in confinement. Birds throw the head forward in a tremulous manner and then falter in gait. They are helpless in an advanced stage. Often birds are found dead in the nest and during heat waves it is advisable to take away the trapnests for that period, yet at the same time frequently clear the nests.

Remedy the defects and keep the bird in the shade; administer a 4-grain dose of sodium bromide every second day. Plenty of Epsom salts should be placed in the water. During heat waves dampen the scratching litter before the heat is at its maximum. Over-fat birds are very susceptible to heat and generally succumb.

Colds and Nasal Catarrh.—The symptoms are running at the nostrils and eyes. It is easily seen by looking for dirty feathers in the neck hackle caused by the bird having a tendency to bury the head round under the wing. It may disappear without treatment early or again develop into one or the other more drastic respiratory ailments.

Syringe out the nostrils with peroxide of hydrogen, place one drop of 5 per cent. argyrol in each eye, and isolate all infected birds. One dose is usually sufficient.

For individual treatment give one (1) grain sulphate of quinine pill per bird.

Bronchitis—Symptoms.—Rapid breathing and a wheezy noise when held close to the ear. The comb and wattles often turn a bluish colour. This colour is due to insufficient oxygen owing to laboured breathing. The causes are exposure, damp quarters, stuffy housing.

Should the birds have an epidemic of bronchitis look to the cause and eliminate it. Individual treatment is laborious, so flock treatment should be resorted to. Give one teaspoonful of tincture of aconite to each 60 birds daily in the water or milk which mixes the wet mash; continue until trouble abates. Twelve (12) drops

of spirits of turpentine in a teaspoonful of olive oil has been found helpful. If it is desired to apply aconite individually, the dose is one (1) drop to a teaspoonful of water daily.

Pneumonia.—Pneumonia is inflammation of the lungs. A cure is difficult as the disease is only evident on post mortem observation. Generally the bird is dead before the disease is suspected. Whenever one notices a bluish comb look for lung trouble. It generally denotes that the bird is not getting sufficient air and may be caused by an obstruction in the windpipe, caused mostly by canker, or may be either bronchitis or pneumonia. A bird dying of pneumonia is often apparently well one day, but dead the next morning under the perches with blood showing in the mouth. Remedy the cause, which will generally be damp and draughty houses or changeable weather ailing a bird which has been forced to sleep in a stuffy house.

Roup.—The first symptom of roup is really chickenpox or fowlpox. It would pay all poultrykeepers to visit their houses after dark. On going along the birds, if one finds a hen "winking," which is an unnatural procedure in a bird, one can be sure that chickenpox (the forerunner of roup) is coming. At this stage it is easily dealt with.

Obtain sixpennyworth of oxide of zinc; the same bulk in flowers of sulphur; mix together with olive oil and lard to a creamy paste. This ointment applied to the affected part of the bird, which will be the eye in this case, is a certain cure.

Should the birds be "running" at the nose, the disease has got a deeper hold. If the bird is worth keeping, syringe the nostrils out with peroxide of hydrogen, using an eye dropper but making extreme pressure when syringing. This will clear out the nostril. The next stage will be "running" eye and cankerous growth in the mouth. At this stage, it is hardly worth while persevering with individual birds. These birds may be eaten; it would pay to kill them all, but they may be treated.

Lift the cankerous growths with a sharp stick and paint the affected spot with perchloride of iron, taking care that none drops down the throat. Sometimes the cankerous growth is in the windpipe. The pipe must be cleared. This is done with a pointed stick, the bird coughing during the operation.

Bleeding must be avoided, and by painting with perchloride of iron the disease will be arrested.

Any further complication cannot be dealt with. The bird will usually die before the operator can do anything. On no poultry farm, well managed, should roup get beyond the chickenpox stage. If fowlpox only is prevalent, the treatment with the ointment before mentioned should be effective.

Any eye trouble should be treated by placing one drop of 10 per cent. argyrol in each eye, night and morning, and should one notice the "winking" symptoms, it would be advisable after treatment with the ointment to put argyrol in each eye.

Roup affects the birds during changeable weather, and in order to prevent its inroads, farmers are advised to treat the water with permanganate of potash to the colour of a deep claret and at the same time put enough kerosene on top of the water to wholly cover it with a film. This treatment started early in March and carried through until the end of May will overcome most of the trouble of roup.

Bumblefoot, a disease caused by bacterial infection setting up an inflammation in the foot producing more or less hard and painful lumpy swellings, causing lameness, may be found.

Do not lance the swelling until it is ripe, then do so on the uppermost part of the foot. Squeeze out the cheesy matter, and syringe out the cavity with a weak solution of iodine; bandage the wound, or bed the bird on clean straw.

Sometimes the swelling comes to a head, which can be squeezed out cleanly and no further treatment is necessary.

We should now be well prepared for the following few months. Pay strict attention to the water supply and shell grit and look to the housing for vermin. Expect trouble from four sources, red mite, depiluming lice, feather lice, and tick.

RED MITE.

This little mite causes enormous losses to the poultry keeper. It is not easily noticed until a pronounced drop in egg production informs the attendant that something is wrong.

The normal colour of the mite is grey but when gorged with blood it is a bright blood red. They live in crevices under perches and nests and at night swarm out and crowd on the bird's body. They suck blood until gorged and before daybreak are hidden away. During hot weather they multiply rapidly and can cause great loss to the farm. They are very small and hard to see but in clusters can easily be recognised.

Every crack and crevice about the house and all perches and woodwork should be treated with "Fleazol" by spraying or painting. Do this at regular intervals.

Do not confound this mite with the red-legged earth mite.

DEPLUMING MITE.

Depiluming mite or itch mite is another cause of loss. This mite is very small and cannot be seen by the naked eye. It saps the feather at its root and evidence of its presence is noted when fowls show a bareness at the abdomen, accompanied by a reddish skin generally called "sunburn" by the beginner. Depiluming mite can go right through a flock of birds and besides being a cause of feather eating among the birds, is unsightly and an irritant. Clean it out by rubbing over the affected parts any vegetable or animal oil; this will immediately effect a cure.

FEATHER LICE.

There are several varieties of feather lice, but for the purpose of this article they will not be discussed in detail.

These lice invade the feathers of the bird and the noticeable symptom is a bird raking the feathers during the day. By examining the bird one can see these lice running on the skin between the feathers, most prevalent just above the vent. Several cases of heavily infested birds have brought to our notice a skin trouble which disappeared with the eradication of the lice. In all cases the birds were importations from other States.

It is a trouble very easy to remedy. Sulphate of nicotine or black leaf 40 when placed on the perches immediately before roosting time will give instantaneous relief. The fumes arising from the nicotine invade the feathers and kill the lice. Only a thin line of the nicotine is required.

TICK.

One should say that in Western Australia this is the most drastic parasite on poultry. Its damage is not noticed until the birds become extremely weak, showing a greenish diarrhoea, but once the general history of its life cycle and habit is known it is easy to eradicate. Its tenacity to life is amazing. Cases have been known where adult tick have lived without food for years. The preferred hosts are fowls and turkeys, although geese, ducks, and pigeons also are attacked.

The amount of blood they draw from the fowls is enormous, but the worst feature associated with tick is the loss caused by their being the agent through which tick fever is spread. This fever is due to the tick being infested with a microbe which is in no way detrimental to it, but when the tick are feeding this microbe makes its way, through the punctures caused when feeding, into the body of the birds, inoculating them with spirochaetosis, or tick fever.

The life cycle from the egg is roughly as follows: The female may lay many lots of eggs, each laying being followed by an engorgement of blood. The average laying is near 600 eggs. On hatching the seed tick crawl on to the fowls and attach themselves in clusters on the birds, usually on the breast and under the wings. They then gorge themselves with blood and within 3 to 5 days fall from the host and search for a suitable hiding place. From then on they feed only at night, returning to their hiding places at daylight.

The adult tick vary from one-fifth of an inch to three-eighths of an inch in size. During hot, dry weather they develop quickly, but during cold spells they are inactive. They are hard to destroy once they obtain a hold in a farmyard.

As they only emerge at night the tick are seldom suspected but their possible presence should always be uppermost in the mind of every poultry farmer.

The periodical cleaning of the sheds and perches and a close examination of all cracks will help to determine the presence of tick before any disastrous results have been felt.

The easiest method of tackling the trouble is to saturate all cracks with Flezol when building and paint all woodwork periodically, taking care that any trees having open bark are also treated. When tick have a hold it is necessary to keep sheds thoroughly clean of manure. Wedge open all joints and spray the Flezol between each joint and crack, spraying from both sides. See that all woodwork is saturated and do not forget the laps in the corrugated iron.

Repeat that treatment at fortnightly intervals and the trouble from tick will abate.

Symptoms in a fowl yard are dullness, prostration, ruffled feathers, lack of appetite, rapid wasting, dirty green and yellow diarrhoea and pale combs.

Fowls that have recovered from an attack of tick fever are then immune, giving the owner a false sense of security. These birds if still housed in a tick infested house suffer the drainage of blood which causes a loss of eggs but show no other marked effects.

Should the owner introduce birds from a clean farm it is most noticeable that the new birds are immediately stricken down with fever and die within a day or two. Such a happening is about the surest sign of the presence of tick, but in too many cases the previous owner of the dead birds has been blamed for disposing of sick stock.

Always have a rag tied round the perch or perches, and frequently examine the rag for tick.

We should now be well armed for the summer months.

MY HORSE IS SICK—WHAT SHALL I DO?

J. F. FILMER, B.V.Sc.,

Senior Veterinary Surgeon, Department of Agriculture

There is a time honoured legend that the following letter was received by a Government Veterinary Surgeon. "Dear Sir, My horse is sick, what shall I do? I trust you will be able to reply by return mail as I am very worried. Yours faithfully, John Smith." Now though this story is firmly believed in all State veterinary departments, and may even be true, the writer has not personally seen a letter worded in exactly this way, but on numerous occasions has painfully deciphered several pages of writing almost as bad as his own, without gaining any further information than that contained in the legendary epistle. The farmer eventually receives the following epistle:—"Mr. John Smith—Dear Sir, In reply to your letter undated, asking for advice concerning the treatment of a sick horse, I have to advise that, unfortunately, the data supplied by you is not sufficient to enable an accurate diagnosis to be made, and I regret that it is therefore impossible to advise you as to treatment. I shall, however, feel obliged if you will forward further details as to symptoms so that I may be in a position to advise you. Yours faithfully, Tom Brown, Government Veterinary Surgeon."

Now I have never been present when a farmer received such a letter, but imagine that after exhausting his rather extensive vocabulary he asks the question, "Now just what do these vets. want, anyhow?" It is the intention of this article to try to answer that question, and to indicate what particulars stock owners should give, when writing to ask for advice about sick animals.

Disease has been well defined as any departure from normal health. This definition indicates very well the type of information that is required for the diagnosis of disease, and it is diagnosis that is the difficult part. Once a correct diagnosis is made, in most diseases, the selection of the best course of treatment is relatively easy. Just a word of warning here. Be very careful about making your own diagnosis. Remember if you write and say "my horse is suffering from inflammation of the kidneys," the veterinary surgeon has no alternative but to prescribe the appropriate treatment for that disease. If your diagnosis is correct, well and good, but if it is wrong then the treatment may prove not only useless but harmful. Remember that diagnosis is notoriously difficult, and unless you are absolutely sure, it is always wiser to send full particulars and let the veterinary surgeon make the diagnosis.

Now, if disease is any departure from normal health, the first thing that is necessary to know is what the animal is like when in normal health, so start your letter with a very careful description of the animal. Give the breed, colour, age, sex and condition of the animal. Mention its temperament, for it is often important to know whether an animal is normally sluggish, sulky, active, nervous, excitable or vicious. If a horse, say whether or not it is broken in and state the purpose for which it is used. If a female animal indicate whether it is pregnant, and if so, for how long it has been in that state. In writing about a cow always say when she last calved and how much milk she is giving. With sheep, say when last shorn and indicate the length and type of wool carried. With horses some indication of the conformation is often of great assistance.

Having carefully described the animal go on to an equally careful description of its symptoms, which are simply abnormalities arising from its diseased condition. Note first of all any wound or swelling or abscess, and if present describe

these carefully. A simple sketch is often valuable. Do not be afraid to attempt this because you are not an artist. The crudest sketch often tells more than several pages of description. In describing swellings, besides indicating their position and shape, always very carefully state whether they are hot, painful, soft, hard or bony, attached to or moveable under the skin, and whether an impression made by pressing firmly with the finger remains after the finger is removed. With wounds always give their size, shape, depth, and the angle to the ground of long cuts. State if there is a flap of skin hanging, and if any bone or other tissues have been exposed. Indicate the nature of any discharges present, giving colour, consistence and odour. If the discharge seems to be coming from a pocket below the wound, indicate the position and size of this. Always say if a wound is near a joint, and if so whether discharge increases when the animal puts weight on the leg in walking. Describe carefully any abnormality in the position of the animal or any of its organs. State whether its head hangs or is held out straight or to one side. Say whether the ears droop, the eyes protude or are sunken, and whether the third eyelid tends to come further over the eye than normally; whether the lower lip hangs, or the tongue protudes, or the nostrils are dilated; and mention any discharge from the eyes, nose or mouth and describe such carefully. Describe any abnormality in the way an animal stands. For example, it may put one front leg forward or it may rest it with a bent knee; it may continually rest one hind leg; it may stand with both legs forward and hind legs well under; or it may stand very stiffly on all four legs. Mention it if the back is bent either upwards or downwards, or if the tail is carried in an unusual position. Note whether the abdomen is unusually distended and whether this is even or one-sided. If the animal lies down say in what position it lies, and whether it lies still or rolls or gets up and down frequently, and always mention it if the animal never lies down. Give any abnormality which you may note in its way of moving. For example, state if it goes sluggishly or walks or trots or gallops in an excited way. Describe any lameness very carefully. Give any indications of pain which may be noticed; for example, groaning or looking at or biting any particular part. Mention any abnormality in the action of the bowels.

Three other things are of great importance. They are temperature, heart beat and breathing. Every farmer should possess a clinical thermometer. The standard human half-minute type is the best to buy as it is both more reliable and cheaper than most of the so-called veterinary thermometers. Do not say an animal is feverish, give its temperature, and this should be taken night and morning and any variations carefully noted. Heart beat can be easily counted by pulling the left leg forward and feeling for the beat with the hand on the left side of the chest. Give the number of beats per minute, and say whether they seem stronger or weaker than normal. Note also if they are regular. The breathing can be watched best from the side. Count the number of times the animal breathes per minute. Note whether the ribs are moved or not and whether there is any heaving of the flanks. State if the breathing is regular. Mention any coughing, and say whether this is harsh or soft, and how frequently it occurs.

Having carefully described the present state of the animal, go on to give a careful history of the complaint. Start off by describing the surroundings of the animal prior to its becoming affected. For example, mention the weather, food, the work that was being done, and particularly mention any changes which occurred in any of these. Then give the date and time of day when first symptoms were noted, and proceed to give the course taken by the disease up to the time of writing.

Give full particulars of any treatment applied, stating doses and times, and any effects which you believe to have resulted.

Should the animal die, a post mortem examination should, if possible, be made. Always prepare an antiseptic solution such as Lysol, 2 tablespoonsful to 1 gallon of water. Wash the hands and arms in this prior to opening the animal and repeat after completing the examination. If you cut yourself dry the part and paint the cut immediately with tincture of iodine. These precautions should always be followed, but especially so if the animal has been dead for any length of time. Anyone with a wound on the hand should not conduct a post mortem on such an animal. Post mortem examinations, to be of real value, should always be made as soon as possible after the death of the animal, as degenerative changes take place very rapidly in the dead carcase. In reporting post mortem examinations always state how long the animal had been dead. Horses and cattle can be most conveniently examined by opening them from one side. After skinning, remove the front and hind legs from the upper side. Note any bruises or other injuries under the skin. Next remove the ribs from that side. This may be done by cutting them away from the breast bone and the back bone with an axe or saw, or they may be removed by cutting between them with a knife and severing the joint between the rib and the breast bone and then bending back singly. The abdomen is opened by cutting down the centre line and around to the upper flank and pulling back the flap. Smaller animals such as sheep and pigs should be placed on their backs and opened down the centre line. The breast bone may be removed by cutting along the line of joints by which it is joined to the ribs. Remove the heart and lungs and examine them carefully. Note if any parts of the lungs are darker coloured than normal, or have become solid instead of spongy. See if they sink in water. Note carefully any fluid in the chest cavity, and any attachments between the lungs and the ribs, also any fluid or other material around the heart. Next remove the stomach and intestines, and in doing this be careful not to injure these with the knife. Now separate the intestines from their attachments so that they lie in one long tube. The small intestines are those which extend from the stomach to the blind gut or caecum, which can easily be recognised in all animals from the fact that it is closed at one end. The large intestines extend from the blind gut to the rectum. The parts of the stomach and intestines in which disease most commonly occurs are the stomach, particularly the fourth stomach in cattle and sheep, the small intestines, the blind gut and the rectum. The large intestine is often the seat of trouble in horses but less often in cattle and sheep. Open any part which seems inflamed and note its appearance carefully. Note any fluid in the abdominal cavity and any attachments between organs and body walls.

Next examine the liver, kidneys and spleen. Note carefully any abnormalities in size, colour and consistence. Open the bladder and note colour of urine present, also any deposit.

Report anything found which seems abnormal and collect samples of the abnormal parts. Generally these do not need to be very large but they should be cut so as to include both healthy and diseased tissue unless the whole organ is diseased. Sections of liver, kidney, spleen, heart and lungs should in general be about one inch square by one-quarter inch thick. Place the sections in a solution made by mixing one part of formalin with nine parts of water, cork them tightly in a bottle of convenient size, pack carefully and forward with your letter. If worms are present the part of the bowel containing them may be placed in the above solution, or the worms themselves may be placed in a solution made by dissolving one heaped teaspoonful of salt in one pint of water. Always mention whether or not the worms are numerous.

So much for single animals. Where a number of animals are affected, certain particulars should be given in addition to the above. Mention the date the first

animal became affected and, if possible, the dates on which subsequent animals were discovered ailing. Give the total number affected, the number of deaths and the number of animals in the flock or herd concerned. Always mention if any animals had been introduced prior to the outbreak, and if so how long before the first case occurred.

To sum up briefly:

1. Describe the animal.
2. Describe all abnormalities noted.
3. Describe the course of the disease.
4. Detail any treatment which has been given.
5. If the animal dies describe what is seen in a post mortem examination and send samples of abnormal organs.
6. In an outbreak of disease, pay particular attention to numbers and dates.

And that, as briefly as can be given it is the answer to the question, "Just what do these vets. want when they ask for details in connection with sick animals."

Published by courtesy of the Australian Broadcasting Commission, being an educational talk given through Station 6WF on 28th September, 1934.

ERRATA

"Journal of Agriculture," No. 1, Volume 11, March, 1934:

"The F. A. Q. Criticised, with a Suggested Alternative," page 9: In the statement showing Home Consumption in Australia "Sea Carriage 24,108 tons at 30/- per ton £36,162" was inadvertently included. The correct statement should read:—

Home Consumption—30 million bushels.

3% of this = 900,000 bushels = 24,108 tons—

	£	£
Sacks—10 million at 9/- per dozen	11,250	
Cartage—24,108 tons at 5/- per ton	6,027	
Railway Freight—24,108 tons at 12/- per ton	14,465	
		31,742

Total £371,261

Total—	£
Export	330,519
Home Consumption	31,742
	£371,261

"Journal of Agriculture," No. 3, Volume 11, September, 1934:

"Herd Testing," page 396, Table—"Mature Cows":—

Ownership of the cows "Pansy 5th of the Hill" and "Gold of Eastview" should read "D. Bevan & Sons, Serpentine," and not "W. G. Burges."

The cow "Koojan Dulcie," H. B. No 1255, owned by Mr. A. W. Padbury, was omitted, her production being 8,994lbs. milk, 5.88% average test, and 520.62lbs. butter fat in 273 days. This record places her second on the list, and Mr. W. G. Burges' cow, "Kurrawong Kitty 8th," will move to third place.

"Factors Influencing the Production of Clean Milk," page 419, paragraph 3, line 2:

"... temperature of 100° Fah." should read "... temperature of 160° Fah".

Page 422, Table at end of page:

"April 2nd . . . 1,000,000" should read "April 2nd . . . 100,000."

AN ENTOMOLOGICAL APPEAL.

As the Green Tomato Bug (*Nezara viridula*) is again showing up in numbers in various districts, the Entomologist would remind growers that the Green Bug egg parasite *Microphannurus megacephalus* has been successfully carried over the winter both in the field and in the laboratory.

Some 30,000 of these tiny wasps were distributed last summer. It is desired to continue this work of breeding and distribution of this beneficial insect, but to

do so it is necessary to secure eggs of the bug. The Entomologist therefore appeals to growers to collect and forward as many rafts of these eggs as possible to the Department of Agriculture, Perth.

The eggs, to be of use, must be of a creamy yellow colour. If they have turned pink they are too far advanced and should be destroyed. If rafts of eggs are found to be turning dark they should be left alone, as the darkening is due to the presence of the developing parasite within the egg.

In return for eggs forwarded, colonies of the parasite will be supplied.

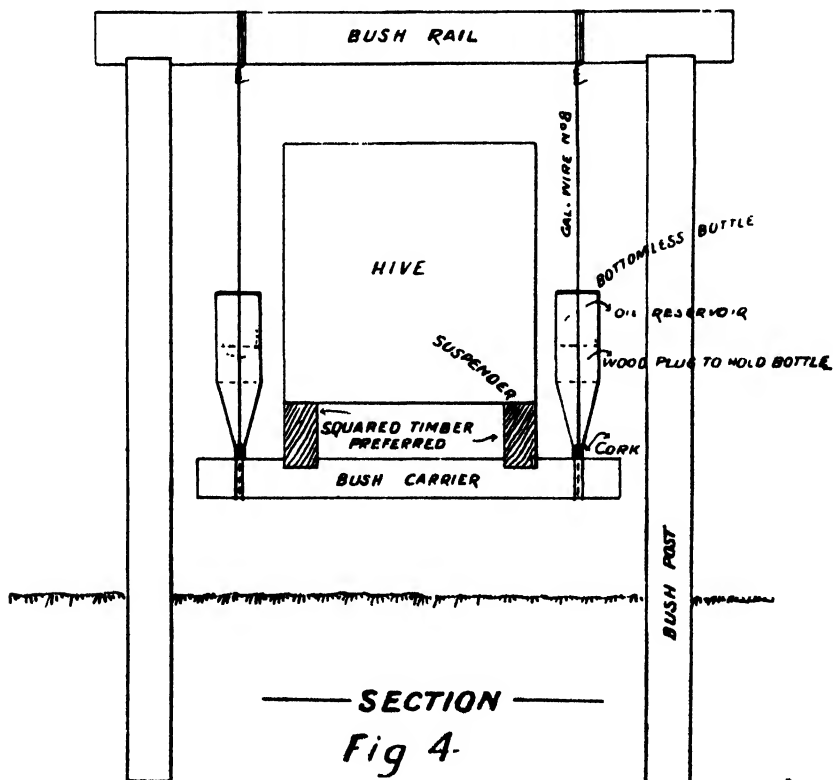
LOCATION AND MANIPULATION OF APIARIES.

(Continued.)

H. WILLOUGHBY LANCE, Apiculturist.

6. Addendum.

A cheap stand may be made with bush posts and old bottles as shown in figs. 4 and 5. The bottles have their bottoms broken off by soaking a piece of string in kerosene and tying round the bottle, lighting the string, then when the bottle is hot dipping it in cold water up to the string. The wire may be threaded through a hole in the cork, or a slot cut in the side. A convenient height for the hives is 12 inches from the ground. About two inches of sand should be placed in the bottom of the bottle.



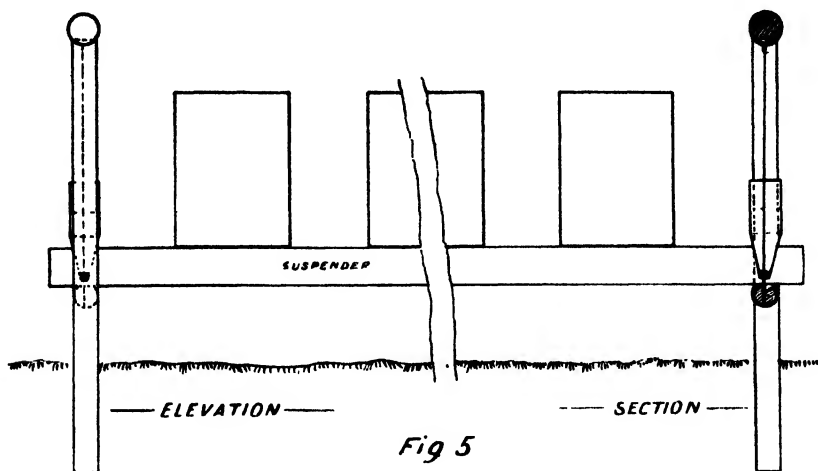
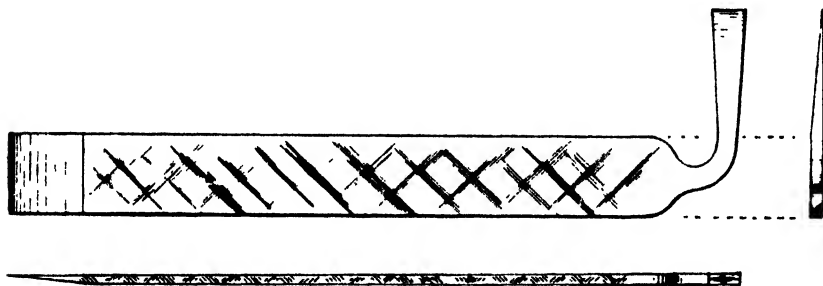


Fig 5

14. Addendum.

Fig. 6 is an illustration of the hive tool referred to in this paragraph.



HIVE TOOL
FIG 6

15. Swarming.

In past days beekeepers anxiously looked for swarms and considered these as part of the success of beekeeping, and would probably boast of the number of swarms from their bees. Those days are past. Beekeepers now count their success by the small number of swarms that issue, and the large size of their hives, their motto being few but crowded hives. One hive of 30 to 40 thousand bees will produce more honey than 3 of 15,000 each.

The problem now is to prevent swarming. This, of course, cannot be done entirely, but by having bees from non-swarming strain, and by study and careful manipulation, swarming can be reduced to a minimum and the honey harvest increased.

Young queens seldom swarm unless the hive is very much overcrowded. Requeening at the end of the season means a young and vigorous queen for the spring. Given plenty of room for brood rearing and honey storage and the right climatic conditions, a young queen is not nearly so likely to swarm as an old one.

Normally, a colony will only throw out one swarm. Some will, however, send out several, and these queens should not be kept or bred from, but young queens

from colonies not inclined to swarm should be introduced. If the beekeeper does not understand queen rearing, he should purchase queens from a reliable breeder or a book on Queen Rearing.

The Causes of Swarming are several. As referred to above the bees may be from a swarming strain, and will swarm at every opportunity without due cause. Re-queening is the only cure for this.

Another cause is that the queen has bred well and filled the brood combs with bees, and they in turn have filled the hive with honey so that there are few empty cells for the queen to lay in, or the bees to store honey. This may be prevented by giving plenty of room in advance, by adding a second, third, or fourth storey as may be required. When this is done one or two frames of brood and one or two of honey should be taken from the lower chamber and placed in the centre of the added one, this will draw the bees into the new chamber; the rest of the chamber being filled with frames fitted with *full sheets of foundation*. The brood in the lower chamber should be closed up to the centre of the hive, one of the new frames with full sheets of foundation next, then the combs of honey and pollen, and if there is still room for new combs, these may be placed on the outside. If drawn combs are available it is preferable that these should be placed between the brood and the honey. Brood combs in the lower chamber should be directly below the brood combs in the upper one and any bar of honey above the brood in the lower chamber should have the cappings bruised to induce the bees to remove the honey and the queen to use the two chambers. Good queens in a good season will breed in both the first and second stories, the third and fourth stories being used for surplus honey.

Another cause of swarming is changeable weather during the spring breeding season. A few fine days with plenty of honey and pollen coming in induces the queen to lay rapidly. Then a few wet and cold days follow and the bees are confined to the hive. More good weather and rapid breeding, then cold and wet, until there comes a spell of bad weather, the hive being full of young bees and the old field bees being unable to go out, there is an overcrowded feeling and they prepare to swarm. Cutting out queen cells may prevent this for a time, but if changeable weather continues and there is a poor honey flow, the bees may make several attempts and at last get away.

Given good weather, a good honey flow, and good bees, swarming can usually be prevented by proper manipulation.

It has been stated that bees have a "one track mind." Under certain conditions the swarming reflex dominates all others. Then again, on account of the irregular and periodic nature of the honey flows, bees have learned to put honey gathering in the forefront of their activities: therefore, when there is a good honey flow on and they have sufficient storage room, the honey gathering reflex dominates.

16. Increase.

It may be asked how to prevent swarming and at the same time increase the number of colonies. This may be done by what is known as artificial swarming.

A normal colony contains bees of all ages. The "baby" bees clean out and polish the cells for the reception of eggs, when a few days old they feed the older larvae with honey and pollen. Later when their brood food glands develop they make the "cheyle food" or bee milk and the royal jelly for the very young larvae. Next they are engaged on general home duties, cleaning the hive, guarding the entrance, storing and capping the honey and pollen. During this later

period they take a number of "play flights" so that they may learn to locate their home and be able to return to it. Lastly, they become "field bees," and roam abroad in search of nectar and pollen.

A natural swarm consists of bees able to perform all duties except those of the very youngest. Therefore, in making an artificial swarm, we must endeavour to make it as near as possible to that of a natural one.

If a colony is a two-storey one, strong in bees of all ages, with plenty of honey and pollen, it may be divided as follows:—

Prepare a new floor board, body box and cover. Move the original hive on one side and place the new one on the original stand. Look through the old hive until the queen is found, then place the frame with the queen in a safe place, so that she will not get back into the hive. Take out three or four combs containing unsealed brood with adhering bees and place in the centre of the new hive, with an empty or partly empty comb on each side, fill up the remaining spaces with combs of honey and pollen. This hive will now be in the same condition as if it had swarmed, except that there will be no queen cells. It is advisable to give it a ripe queen cell or a young queen, or if these are not available, it may be allowed to breed up one of its own. This, however, will mean a delay of three or four weeks before any further eggs are laid, and 6 weeks before the young bees emerge.

This original hive should contain one or two frames of capped brood with as little uncapped brood as possible, some combs of foundation or empty combs and two or three of honey and pollen, the frame with the queen being placed in the centre. The entrance should now be closed with fly wire and the hive stood in a shady place. On the evening of the day following it may be placed on its permanent stand; the fly wire removed and the entrance lightly stuffed up with fine grass so that the bees cannot get out next morning without pulling it away. This will cause them to take new bearings, and only those that come out late in the day after the grass has been removed may find their way to the old stand. This hive will now contain bees of all ages, the original queen, and a little emerging brood, and given a honey flow will rapidly build up to a strong colony.

The following plan for making three colonies out of two is from "The Bee World" by L. Illingworth, and should be an excellent one and secure a larger crop of honey as well as increase of colonies than with the dividing method.

"When the weather is warm and colonies strong, but if possible, just before preparations are made for natural swarming, take two good colonies, A and B, place the comb with queen and adhering bees from A in the empty hive, fill up with frames of foundation or empty combs, and set it on stand A in place of the original colony. Put roof on the new hive now on stand A. Now open the old colony A which has been moved aside, select about half the remaining combs containing unsealed brood, shake and brush the bees off them on to the alighting-board of the new hive, letting them run in to join their queen there. Replace these brood-combs in the old hive where they came from in the same order, inserting an empty comb or frame of foundation to fill up the gap where the comb with the queen was taken. If queen cells are seen the best should be left and that comb set aside and not shaken. All other combs should be examined, whether to be shaken or not, and all other cells destroyed. Close the hive containing the brood and remaining bees and set it on stand B removing hive B to a new position C. Stand A now has all its old flying bees, half its young nurse bees, their own queen and one comb of brood. Stand B has all its old flying bees, all A's brood, and half A's young nurse bees, but it is queenless. If a queen cell has been left or given, then an examination must be made a few days later to make sure it has not been

destroyed. Otherwise a young queen must be introduced or the colony allowed to raise one. Stand C has B's queen and brood and all B's young bees, but no flying bees. The bees on stand C will therefore be able to feed any amount of brood, but will be unable to defend their hive or to forage until they grow older. As the operation will be carried out when the weather is warm and during a honey flow, there will be little danger of robbing, and there should be a good amount of honey in the hive, so with care and attention on the part of the beekeeper no trouble should arise."

A still better plan of making three colonies from two, and which the writer considers simpler, is as follows:—

Proceed as before but use only foundation in the empty hive on stand A except the one comb with brood and queen. This is to prevent the colony swarming later, as it might if drawn-out comb were used. Shake and brush *all* the bees from *all* the remaining combs into the new hive on stand A. This makes a very strong swarm with bees of all ages. Replace all the bare brood and honey combs from which the bees have been shaken in the original body-box if suitable, after shaking off any bees that are still clinging to it, or in a deep super, keeping them in their original order, filling up the space from which the comb with the queen was taken by closing up the brood combs and putting a spare comb or frame of foundation on the outside. Now remove the roof from colony B and set the box of bare brood on top of B over a queen excluder and cover up. If colony B has already got a super on with an excluder, just put the brood on top of the super. Do not move colony B. In the course of an hour or so numbers of young bees will have come up from below to attend to all this extra brood. As soon as the brood is seen to be well covered with bees, remove it bodily and set it up in a new hive in a new position. The entrance should be contracted so that only one or two bees can get in at a time to discourage robbing. Unless plenty of honey was seen in the combs when shaking the bees, a comb full of honey should be given to the C colony, or it may have to be fed. A queen cell or young queen should be given when setting up the new colony C.

MILK AND CREAM STORAGE.

M. CULLITY, Senr., Agricultural Adviser, Dairy Branch.

Previous articles in this Journal have emphasised the necessity of care and strict cleanliness in handling dairy produce. The principles underlying the various operations recommended have been explained, and it is felt that good results are accruing.

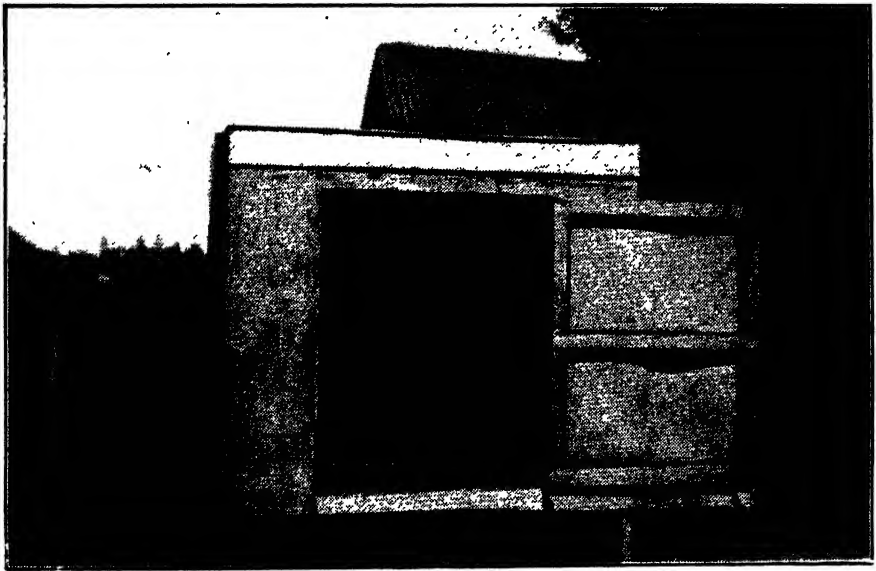
The same principles governing the care of milking yards, sheds, and utensils apply also to separator and cream storage rooms. Inferior cream is frequently traced to faults in these rooms. Unclean floors, contaminated with spilt milk and cream, are developing grounds for bacteria which find their way into the atmosphere and so directly contaminate the fresh milk and cream. Uneven floors, walls and ceilings also provide areas which more readily collect dust of various forms which is dispersed again through the room by air currents.

The disposal of wash water directly outside the store or separator room, or the use of this water for washing down the floors, must also be condemned, because of the presence of milk constituents which would prove helpful to the development of

harmful bacteria on the floors or in the immediate vicinity of the room. For washing floors of dairies or the benches or tables installed therein clean boiling water and soda is recommended. A broom on the floor and a scrubbing brush on the woodwork will facilitate keeping these in good order.

The dairy is provided for the storage of milk and cream only. No other material should be stored within its walls. Milk is a particularly delicate article and is easily damaged by odours or taints absorbed from articles stored in the vicinity. Perhaps the most disagreeable absorbed taint is that from a dirty cow-yard, which is one of the many reasons for keeping the yard clean and for having the dairy some distance away from it. Odours may be absorbed from fruits, meats, and vegetables, which are frequently stored in or near dairies. It is on this account that regulations require that milk or cream should be stored separate from other produce.

In addition, apart from the damage done by air-borne contamination from the floors and walls of a dairy and from absorbed odours, attention must be drawn to the effect of faulty construction, leading mainly to bad ventilation such as occurs in cellars. The result from this condition is a musty flavour and smell in the produce.



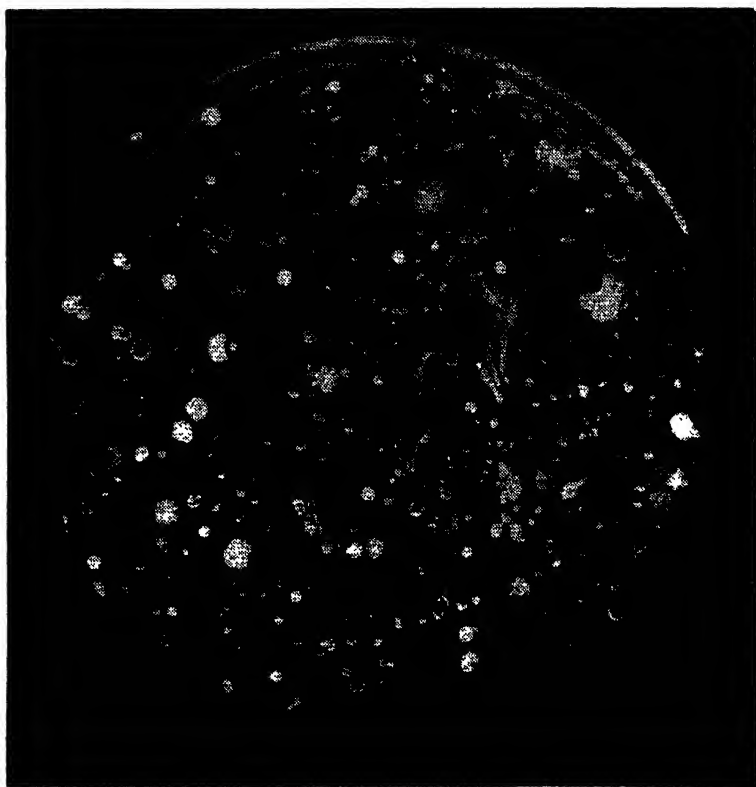
I. Type of Coolgardie safe proved unsuitable for the storage of cream.

The desire to put into effect the recommendations regarding the cooling of milk and cream is responsible for the use of the Coolgardie safe in this connection. While these are fairly effective in reducing the temperature inside their walls, attention must be drawn to the danger of the use of these safes if the hessian sides are allowed to become dry. A considerable amount of dust is caught on this material during a season and there is a possibility of some splashes of milk reaching it. The result is that when dry the slightest movement of the safe means the unloading into the atmosphere inside of millions of bacteria and spores. These settle on the surface of the milk or cream and are eventually stirred in. A still

more serious position arises where air currents can disturb or flap the sides. This means a continual movement with resultant increase of the bacterial concentration of the air inside the safe. Specific cases have been noticed within the last few months where these safes have been the cause of inferior quality cream being produced.

For purposes of illustration one such case may be cited, which was investigated in conjunction with the management of the South-West Co-op. Dairy Farmers, Ltd., Bunbury.

The cream received from a certain farm was being continually "second graded" on arrival at the factory. A visit was made in order to assist in locating the trouble. Various faults were seen which would result in inferior quality, such as, failure to scald the milking machine, and the hot water supply being at some dis-



II.—Plate exposed for two minutes in safe shown in Illustration I.
The large growths are moulds. The smaller being bacterial colonies.

tance from the sheds. These and other faults were remedied but trouble was still experienced with the cream, which had a peculiarly unpleasant flavour. The management of the factory then demonstrated that the methods advised and being used were successful inasmuch as the cream coming from the separator was sound, but after the storage on the farm the peculiar flavour referred to became evident. The points between the separator were then checked and the safe used for storage purposes tested by exposing a plate containing a culture on which the bacteria could

fall, and after growth be conveniently counted. This plate was exposed for two minutes, the walls being moved gently as if by the wind, as the safe was in an exposed position where any breeze could reach it. The result allowed no doubt that the safe was the cause of the flavour, as the organism predominating in the cream was identical with that obtained from the safe. The exposed plate is shown in Illustration 2, after the organisms had developed into colonies. Each spot in the latter represents where at least one micro-organism fell and developed into numbers sufficiently large to be seen by the naked eye.

This safe was in a position where prevailing winds could reach it, thus helping to cool the cream within it by assisting evaporation of water from the hessian sides in the summer months, but with undesirable results whenever the hessian was allowed to dry.

It is recommended that all due precautions be taken in the use of these safes to prevent a possibility of the sides becoming dry. A good idea is to line the safe with perforated zinc and to have the hessian covering on the outside. It can then be used as a cooler in the summer and as a fly-proof safe in the winter months by simply removing the hessian.

Dairies lined with hessian or similar material, whether whitewashed or not are also likely to cause trouble.

Where dairies are covered by creepers or shade trees to lower the temperature during the summer months, it is recommended that accumulation of dead leaves or superfluous growth should be prevented by periodical pruning or clipping, as such dead matter would be a means of providing dust in windy weather which might contaminate the dairy produce stored in the dairy.

FRUIT EXPORT SEASON, 1934-35.

GEO. W. WICKENS, Superintendent of Horticulture.

A vital change in the regulations governing the export of apples from Australia will take place next season, with the introduction of colour grading, and until packers become used to selecting fruit of sufficient colour for either of the only two grades permitted shipment (Extra Fancy and Fancy), the number of cases packed per day will be considerably less than under the previous regulations, when size and blemish were the principal factors. Though packing will, necessarily, be slower, I am certain the alteration will prove beneficial, and will result in more uniform and better quality fruit being shipped.

In normal seasons in Western Australia apples colour well, but a bad fault in the past has been a mixing together in the same case of highly coloured, moderately coloured and non-coloured fruits. This undesirable mixture will not receive, under the new regulations, a permit to export, even though every apple in the case complies with regulations in other respects. The colour requirements will be divided into: "Solid Red," "Partial Red," "Striped" and "Yellow or Green," and every variety of apple permitted to be exported will be named in the regulations and placed under one of the above headings.

"Solid Red" apples, such as "Democrat" to be of "Extra Fancy" grade, must have 70 per cent. of the surface of every apple covered with red, and for "Fancy" grade must have 35 per cent.

"Partial Red" apples such as "Jonathan," "Delicious" and "Rokewood" must in "Extra Fancy" have 50 per cent. of red colour, and in "Fancy" 20 per cent.

"Striped" varieties such as "Nickajack" and "Statesman" must have 30 per cent. red colour in "Extra Fancy" and 10 per cent. in "Fancy."

"Yellow and Green" apples must not be mixed together in the same case, but either yellow or green apples of the same variety may be labelled "Extra Fancy" if they are packed separately, and are of "Extra Fancy" quality.

The only change in the grade standards for pears will occur in the naming, "Extra Fancy" taking the place of "Special"; "Fancy" taking the place of "Standard," and "Good" taking the place of "Plain."

Particulars given hereunder of grade standards, including colour requirements and sizes, are as recommended to the Department of Commerce by the Apple and Pear Council, and it can be taken for granted that the regulations when printed will closely approximate these. I, therefore, most earnestly commend them to growers and packers for serious consideration so that the disappointments and heart-burnings caused by rejections at the ports may be kept down to a minimum.

GRADES FOR APPLES.

Blemish Tolerance.

Extra Fancy Apples shall consist of sound, clean, well-formed mature apples of one size and one variety, free from broken skins and from disease. Slight blemishes from any cause may be permitted, provided such blemishes do not exceed 10 per cent. by number of the total fruit in any case, and provided that the total area covered by such blemishes on any apple does not exceed the area contained in a circle having a diameter of one quarter of an inch.

Russetting shall not be considered a blemish, provided that not more than 10 per cent. of the surface of each apple is affected. No apple in this grade shall be less than $2\frac{1}{4}$ inches in diameter.

Fancy Apples shall consist of sound, clean and fairly well-formed mature apples, of one size and one variety, free from broken skins and from disease.

Slight blemishes from any cause may be permitted, provided such blemishes do not exceed 10 per cent. by number of the total fruit in any case, and provided that the total area covered by such blemishes on any apple does not exceed the area contained in a circle having a diameter of one-quarter of an inch.

Russetting shall not be considered a blemish, provided that not more than 30 per cent. of the surface of each apple is affected: provided this does not apply to the Sturmer variety—each apple of which may be 50 per cent. russeted. No apples shall be less than $2\frac{1}{4}$ inches in diameter, except in the case of specified varieties.

VARIETIES OF APPLES—COLOUR REQUIREMENTS.

Solid Red—70% Extra Fancy, 35% Fancy.

Democrat	Duke of Clarence	King David
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Partial Red—50% Extra Fancy, 20% Fancy.

Crofton	Yates	Scarlet
Geeveston Fanny	Aromatic	Rokewood
Jonathan	Delicious	Australian Beauty
Worcester Pearmain	Dougherty	Schroeder
Tasman's Pride		

Striped Varieties—30% Extra Fancy. 10% Fancy.

Alexander	Pomme de Neige	Crow Egg
Cox's Orange Pippin	Ribston Pippin	Nickajack
King Pippin	Statesman	Prince Alfred
Rome Beauty		

Yellow or Green—Uniform Colour.

Cleopatra	French Crab	Stewarts
Newtown Pippin	London Pippin	Alfriston
Sturmer	Mobbs Codlin	Dunns
Stone Pippin	Reinette du Canada	Granny Smith

Class.	Variety.		Size.
Dessert ...	Cox's Orange Pippin	...	2in. to 2½in.
" ...	Crofton	...	2½in. to 2½in.
" ...	Jonathan	...	"
" ...	King David	...	"
" ...	King Pippin	...	"
" ...	Pomme de Neige	...	"
" ...	Yates	...	"
" ...	Worcester Pearmain	...	"
" ...	Scarlet	...	"
" ...	Aromatic	...	2½in. to 2½in.
" ...	Cleopatra	...	"
" ...	Delicious	...	"
" ...	Dougherty	...	"
" ...	Geeveston Fanny	...	"
" ...	Newtown Pippin	...	"
" ...	Ribston Pippin	...	"
" ...	Rokewood	...	"
" ...	Sturmer	...	"
" ...	Statesman	...	"
" ...	Australian Beauty	...	"
Culinary ...	French Crab	...	2½in. to 3in.
" ...	London Pippin	...	2½in. to 3in.
" ...	Mobbs Codlin	...	"
" ...	Reinette du Canada	...	"
" ...	Stewarts	...	"
" ...	Schroeder	...	"
" ...	Alfriston	...	2½in. to 3½in.
" ...	Prince Alfred	...	"
Dual Purpose ...	Alexander	...	2½in. to 3in.
" ...	Crow Egg	...	"
" ...	Duke of Clarence	...	"
" ...	Dunn's	...	"
" ...	Granny Smith	...	"
" ...	Rome Beauty	...	"
" ...	Nickajack	...	"
" ...	Tasman's Pride	...	"
" ...	Stone Pippin	...	"
" ...	Democrat	...	2½in. to 3½in.

In the sizes given above it will be noted that "eighths" are for the first time to be mentioned in regulations, and that Cox's Orange Pippin is the only 2-inch variety to receive an export permit.

In conclusion, I would point out that at time of writing (November) the outlook for an abundant crop of prime apples was never better, and the task of living up to, and packing up to, the new grades will be much easier than in a year of light crops with over-sized fruits and drab colours. Christmas will be with us when this Journal reaches growers, so I shall take the opportunity of wishing all a festive time in the holidays and an export season in the New Year free from permit refusals and inquiries under Part XV. of the "Commerce Act."

SUMMER FODDERS.

C. GILES, Dairy Instructor.

Preparing the Seed Bed.

Many acres of land are now being ploughed for the seeding of maize, Sudan grass, Japanese millet, etc., and whether these crops are to be grown on irrigated or non-irrigable country, the thorough preparation of the seed bed is of primary importance.

Fallowing.

This practice, although desirable, is not at present generally adopted, and many acres of maize, etc., may be seen each year returning yields which are both disappointing and unprofitable.

There are two chief causes of failure:—

1. The selection of unsuitable land; and
2. Insufficient preparation of the seed bed prior to seeding.

These crops grown for summer use require warm, congenial conditions, and cannot be expected to thrive unless these requirements are present. Therefore, well-drained country is desirable and the practice of fallowing should be adopted in order to conserve sufficient moisture to carry the crop to maturity, and the practice would also assist in providing the firm seed bed which is so desirable.

Under a system which provides for the working of fallowed land, the use of a roller to break clods or compact the soil is unnecessary.

During the period of fallow, any clods that may have been present originally after ploughing will have been weathered down into good tilth, and the soil is more thoroughly compacted by the forces of Nature than could possibly be done by any farming implements. The practice usually adopted of ploughing the land almost immediately prior to seeding and of harrowing once or twice before sowing, does not permit of a firm seed bed being prepared.

Need for Care.

In following the above practice, every care should be taken to thoroughly consolidate the soil prior to seeding. The plough by cutting off a layer of surface soil, and returning it loosely and partially inverted, breaks the connection between the undisturbed lower soil and the surface, and consequently forms a most effective mulch. This is especially the case if a sod or the residue of a green crop has been turned under.

It will be seen, therefore, that unless thorough working takes place, in order to re-establish the connection between the surface soil and that beneath, the flow of water upward by capillarity will probably be insufficient to bring about satisfactory germination, especially when seed is drilled and placed in the loose ploughed layer.

Should rain fall sufficient only to secure germination, there is every possibility that, should dry conditions follow, the grain will be "wilted" sufficiently to cause partial if not total failure.

The use of the disc cultivator on clay land prior to ploughing has been found effective in preventing the formation of large clods, which are difficult to work down to the fine tilth necessary to ensure an adequate supply of moisture for the seed to germinate.

THE DIPPING OF FLOCKS AS A ROUTINE PRACTICE IN SHEEP RAISING.

H. McCALLUM, Sheep and Wool Inspector.

W. McC. JOHNSON, Cadet.

Although this Department, year by year, makes an appeal to sheep farmers in the South-West Division of the State to regard the dipping of their flocks as part of the annual routine of sheep raising, just as is the culling or the shearing, the number of flocks infested with lice and tick does not decrease. As it has been frequently shown that one dipping in a suitable dip will maintain a flock free from lice and tick, it appears that either this operation is not being performed with sufficient care to ensure its effectiveness or it is not being sufficiently widely carried out to prevent the dangers of reinfestation from outside sources.

Perhaps the most common cause of failure of the dip to free the flock from lice and tick is that the instructions for mixing issued by the manufacturers are not strictly adhered to. In order to prepare the dip at the suggested strength it is desirable firstly to measure the capacity of the bath. One method of doing this is to run in water from a tank of known capacity and to make a mark on a measuring rod indicating the level of the water after successive quantities of, say, 100 gallons have been added. Once the capacity of the bath is known the dip may be added in the proportions suggested. The dip should be thoroughly cleaned out before preparing the bath. If only hard or saline water is available it may be softened by adding 3 lbs. of washing soda to every 100 gallons.

The dips commonly used may be divided into (a) the poison dips and (b) the contact dips, which are frequently erroneously called non-poisonous. In the first group the essential constituent is generally arsenic in some form, while the second group contain cresylic acid and other coal-tar derivatives. Generally speaking, either group of dips will give satisfactory results, but this Department recommends the powder dips, because, owing to their sulphur content, they are generally more lasting, while the carbolic dips if manufactured from impure tar products may injure the wool.

A second cause of failure in dipping is that the sheep are in the dip for too short a time. It is necessary that the animals should be immersed for at least one minute. Their progress through the dip may be checked if necessary. It is also necessary to duck each sheep at least once so that the dip will reach all parts of the skin.

In regard to reinfestation from outside sources the chief danger lies in contact with undipped sheep. In order to minimise these dangers a clean muster must be obtained and all sheep, including ration sheep, should be dipped. Secondly it is advisable to regularly inspect all boundary fences to make sure they are secure.

Another possible cause of reinfestation is the placing of sheep in sheds or yards where infested sheep have recently been. It is probable that this is seldom a source of danger, as various experimenters claim to have shown that three weeks is the maximum period which these parasites can live away from the animal body.

The most suitable time to dip a flock is from four to six weeks after shearing. They should not be dipped when they are hungry or thirsty, nor on the other hand when they are gorged with food. They should be dipped in dry settled weather, and work should be stopped early so that they may dry before nightfall. If the sheep are hot with travelling they should be allowed to cool down before dipping is commenced.

In 1895 legislation was enacted to enforce the annual dipping of all sheep in the South-West Division of the State with a view to eliminating the serious annual loss resulting from the ravages of lice and tick. It is believed that the value of the wool from an infested flock may frequently be reduced by as much as 6d. per lb. This reduction in value is due to the fact that infested animals scratch and bite at their wool and rub against convenient objects such as fences and logs in an effort to allay the irritation caused by the parasites.

The legislation to which reference has been made is contained in a section of the Stock Diseases Act, which provides that—

- (1) all sheep in the South-West Division of the State shall be dipped on or before the first day of February of each year;
- (2) the owner or occupier of the land on which the sheep are depasturing shall be responsible for the dipping;
- (3) no sheep infested with tick or lice shall be offered for sale either privately or by auction or removed from the property on which they are being depastured until they have been dipped.

The Act also provides that within fourteen days of the dipping of his sheep the owner shall make a statutory declaration before a Justice of the Peace stating that he has dipped his sheep in accordance with the provisions of these regulations, advising of the date of dipping, the number of sheep dipped, and the class of dip used, and that he shall forward this declaration to the Chief Inspector of Stock.

It is intended in the future to administer this Act more rigorously in an effort to combat the growing menace of lice and tick infestation.

CAULIFLOWER PRODUCTION.

W. E. COLLINS,

Potato Branch, Department of Agriculture.

Cauliflower is not one of the easiest crops to produce. It requires close personal supervision and congenial climatic and soil conditions. Since the industry is a highly specialised one, the individual who grows cauliflowers consistently year after year will find it more profitable, as a rule, than one who produces them intermittently.

Cauliflower develops best in those areas where the temperature during the latter part of the growing period is cool and uniform, and where fairly moist conditions prevail. Extremely low temperatures while the plant is young may cause it to "button" or head prematurely. Low temperatures delay maturity, reduce the size, and consequently lower the acre yield.

Hot weather during transplanting time may interfere with the rapid establishment of the plants in the field. If it occurs while the head is maturing it often causes yellowing and gives it that "fuzzy" appearance so often met with. High temperatures appear also to stimulate the growth of the head leaves and in many cases, causes them to appear through the top of the flower. The head itself often grows so rapidly under these conditions that harvesting at the best stage of development is almost impossible, especially when large numbers are being handled. Areas subject to cool climatic conditions usually suffer smaller losses from over-maturity.

Cauliflower should always have a sufficient supply of moisture in the soil to insure a continuous and steady growth. It does not thrive in dry sections, especially if they are subject to extremes of temperature or to dry wind storms. This crop makes its best development in a moist atmosphere. Well distributed rainfall or carefully regulated irrigations are necessary for the successful production of this crop. These conditions help to produce maximum yields, large sizes, and good quality.

Cauliflower can be grown profitably on a variety of soil types. Generally speaking, however, the soil selected should be fertile, of good physical condition, retentive of moisture, and well drained. Where a number of different soil types are available, the medium and heavy soils should be used for varieties suitable for late plantings, as they are cool and retain moisture well. When it is to mature during the rainy season, the crop should be planted in sandy or silty soils. These are usually so well drained that cultivation and harvesting can be done without puddling the land. Though such soils produce good crops during the rainy season, they make low yields when used for very early or very late plantings. Soils of very light texture should be used for cauliflower production only when they are abundantly supplied with organic matter, which increases the water-holding capacity and cuts down labour by decreasing the number of irrigations needed.

In most of the cauliflower-growing districts around the metropolitan area, the plants are started in the open. The two types of seed beds generally used are the sunken panel bed, and the raised seed bed. Where the soil is light and porous and not subject to packing, sunken seed beds are preferable. A given area of land in sunken panels will probably accommodate more plants than the same area in raised seed beds. Moreover, sunken beds have a minimum of surface exposed, and hence dry out more slowly than raised beds. On the heavier types of soil that form a thick crust after watering, raised beds have usually been found more satisfactory, as they facilitate quick growth.

Seed should be sown in drills, 12 inches apart and sufficiently deep to be in contact with moist soil, but not deep enough to prevent the germinating seedlings from reaching the surface. One-half to three-fourths of an inch in depth is usually sufficient. In hot dry weather, the depth should be greater than in cool moist weather. Sow for early crops during December, and continue sowing for later crops until June. A chart of the varieties and the dates of planting in the seed beds will help the grower to avoid confusion and mistakes at times of transplanting, when more than one variety is sown. Care should be exercised to develop healthy stocky plants. If the seedlings are too thick in the bed, they should be thinned to prevent overcrowding. Under the best soil and climatic conditions, and with a well-prepared seed bed, it may be possible to produce good plants without the addition of water after the seed has been sown. The best growers water only when absolutely necessary. A watering shortly before pulling the plants produces succulent roots, many of which die during transplanting. The shock of transplanting is less severe if the plants have been deprived of water somewhat and have been allowed to harden, than if they are in a tender, rapidly-growing condition. If the soil is hard and the plants cannot be pulled readily, the beds should be watered the day preceding pulling. It is best not to wet more of the plant bed than will be used the following day. However, if the soil is loose this watering is unnecessary. Plants are usually of sufficient size for transplanting six to nine weeks after seeding, depending upon the time of the year. A surplus of plants should be grown, so that only the best and strongest need be used for transplanting. Only the largest are removed at first. A watering should be given immediately after the first pulling to stimulate the growth of the remaining plants.

An effort should be made to secure a uniform continuous growth. If plants remain in the seed bed for too long a time, growth is severely checked and premature heading is often brought about. Soil which does not hold water well should be watered frequently enough to promote an even and normal growth. Water should be withheld about a week or ten days before pulling. Usually only two pullings should be made from a bed. If the leaves are very large, they may be trimmed to reduce the loss of water. Plants which are well hardened need very little, if any, cutting back of the leaves.

After the plants are pulled, every effort should be made to get them into the ground quickly, and whatever replanting is necessary, should be done as soon as possible. Crowding should be avoided, as it reduces the size of the head. Rows should be 34 to 36 inches apart, and plants about 24 to 30 inches apart in the row, depending upon the variety.

It is very essential that the different varieties and strains be planted at the proper time. Experienced growers claim that each variety has a definite limit in planting dates, beyond which favourable results cannot be secured, and that only varieties which have been developed for a particular season of the year should be used.

Some growers make plantings every ten days or so, beginning with "first earlies" then continuing with "second earlies," and so on to the later varieties. Others specialise in a general or main crop such as the "Mid-Summer Beauty" or the later "Veitch's Autumn Giant." Another variety "All the Year Round" has found favour with not a few as a single variety cropper. However, though different growers vary their planting procedure somewhat to suit their local conditions, their main object is to have a continuous harvest throughout the season.

The aim of the grower should be to produce heads of a medium large size, for which there is usually a good demand, therefore the soil must be made sufficiently fertile to produce this quality. A large head cannot be obtained from a small plant. The plant food elements should be present in available form and in sufficient amount to give a continuous growth. While phosphorus, potash, and other plant food elements are necessary, the one most generally needed is nitrogen. There is considerable difference of opinion among growers as to the value of the various fertilisers. Many of the more successful growers have large supplies of stockyard manure available. Cauliflower fits in well with dairying; and an abundant supply of manure may thus be obtained. Where livestock is kept on the same farm, the task of maintaining the soil in a highly productive condition is not a difficult one. Ten to 20 tons of manure may be considered a good annual application. If the farmyard manure cannot be obtained in sufficient amount to supply the needed organic matter, green manure crops alone or with commercial fertiliser may be used. The cover crop or green manure crop, preferably a legume, chosen should be adapted to the local conditions, and should produce a good tonnage of vegetable matter to plough under.

In certain cauliflower sections, the high price of land prohibits the planting of green manure crops, and the productivity of the soil, therefore, must be maintained largely by the use of commercial fertilisers. The three constituents supplied in a complete fertiliser are nitrogen, phosphorus and potash, and these are to be found in well-balanced proportions in the ordinary commercial potato manures. It is impossible to specify a single kind or a uniform rate of application of fertiliser for the entire State, or for any large district within the State. It is best for each grower to make a number of tests of his own land to determine the kind to use and the most profitable amount to supply. In general, growers have found that it is the lack of nitrogen which limits the growth of the cauliflower

plant. Nitrogenous fertilisers, therefore, usually give the greatest growth response, and a mixture much in favour with our most successful growers is composed of potato manure and blood and bone in the proportion of 5 bags of the former to 3 of the latter. An application of about 10 to 12 cwt. of this mixture to the acre should give good results. If the plants are making a slow growth or if they appear yellowish green, a side dressing of 100 to 150 pounds of nitrate of soda or sulphate of ammonia to the acre usually causes a quickening of the growth rate and a darkening of the leaves.

The market demand is for a pure white head. Varieties such as "Early Snowball" have a small amount of foliage, which neither covers the head nor protects it from the weather. To prevent discolouration it is necessary, therefore, to gather together, and tie or pin the outside leaves over the head. Breaking the leaves over the head, a method sometimes used, is unsatisfactory, as the wind is likely to displace them. Moreover, if they decay, a yellowing of the head results. When the head is small, it is well protected by the small inner incurving leaves. As it increases in size, the leaves gradually lift, thus exposing the head. Some varieties of cauliflower such as the "Mid-Summer Beauty," "Dwarf Erfurt," "All the Year Round," etc., are sufficiently protected until the heads are ready for harvest and, therefore, need not be tied. The length of time necessary for the development of the heads to a marketable condition after tying depends chiefly upon the temperature. During warm weather they may be ready for harvest within two or three days, but during the cooler part of the year, as long as two weeks may be required. It is imperative that the heads be cut while they are compact. It is a common error to allow the head to get past its prime before cutting. There is very little danger of cutting the heads before they have made their proper size. If the plants have not made good growth, the heads will not grow large, regardless of the length of time they remain in the field. It is generally considered a better policy to disregard the size feature at the time of harvest and consider only the stage of maturity. Again, the stage of development of the head affects very markedly its carrying qualities. The longer heads are left in the field after they are ready to cut, the more wilted they appear when they reach the market. If the head has begun to separate and spread, it deteriorates much faster than one compact at the time of cutting. Occasionally during a rush period, the cauliflower heads are cut and left inverted in the field for a short time. This checks the growth and prevents losses that might otherwise occur. Growers should always picture the appearance of the head at the time of arrival at market. Appearance is an important factor in the sale of any commodity, and even one over-mature head in a pack may spoil the appearance of the entire lot. Over-mature heads are very conspicuous because the advanced growth spreads the leaves and exposes the flower. Young ones are more concealed in their jacket leaves and, therefore, attract less attention. Leafy heads are those which have small green leaves appearing between the flower segments. Heads of this type are undesirable, and if possessing many leaflets, should be discarded. This condition is usually due to seed of poor quality.

So far, the chief problem of the cauliflower grower has been that of acquiring good seed. As a general thing the production of seed by the average grower is not to be recommended, because of the insufficient care exercised in the selection of the seed stock and in roguing out the undesirable plants. Although a little seed has been produced by individual growers from good strains introduced from Italy and Holland, so far as is known no one has made a special effort to improve this stock. As a result, in those districts where cauliflower is an important commercial crop, opportunity awaits anyone who will make a specialty of breeding strains of higher quality and greater uniformity.

The best means of obtaining good seed is to reserve several well-rogued rows on one side of the field, far removed from any other plants of the same family. Cauliflower is mostly insect pollinated, so the greater the distance the less the danger of cross pollination. Only the best heads in these rows should be allowed to develop. Often neighbouring plants too poor to cut for market are unintentionally allowed to bloom. These cross readily with the selected plants, and the progeny are usually worthless. Since cauliflower, and all varieties of cabbage, kale, Brussel sprouts, and kohl rabi cross freely, these crops should not be grown in close proximity.

It is sometimes necessary to cover the maturing plants with mosquito netting, so that birds cannot break open the pods and eat the seed. When the pods are brown in colour, the plants are cut and laid on large canvas sheets to dry. In two or three weeks, the seeds can be rolled out with a large wooden roller, or threshed out with a flail. The seed is then cleaned and placed in strong muslin bags. These bags are only partially filled so that they may be turned about every day for about two weeks and the seed cured thoroughly.

DENMARK WASTING DISEASE.

J. F. FILMER, Senior Veterinary Officer.

E. J. UNDERWOOD, Animal Nutrition Officer.

Denmark Lick No. 1 has now been tested sufficiently to enable the claim to be made with some confidence that it will both cure and prevent wasting disease when it is used in accordance with the instructions issued in the March, 1934, number of this Journal.

It has been used on the departmental experiment farm since November, 1932. Three Denmark settlers have been using it since August, 1933, and a number of others have been using it for shorter periods. Numerous cases of wasting disease have been cured and in all cases where its use has been systematically continued heifers have continued to grow well and cows have remained in good condition.

Wasting disease is not generally noticed in young unweaned calves but recent observations made on the experimental farm show that growth is subnormal unless they receive the lick. None of the calves in the following table showed obvious signs of wasting disease, but the difference in weights between those which did and those which did not receive the lick is very striking.

Lick.				No Lick.			
Calf.	3 Months.	6 Months.	10 Months.	Calf.	3 Months.	6 Months.	10 Months.
	lbs.	lbs.	lbs.		lbs.	lbs.	lbs.
33 ...	166	282	370	1 ...	141	240	304
34 ...	186	308	398	3 ...	186	257	351
37 ...	191	351	475	14 ...	171	288	307
38 ...	204	368	514	15 ...	181	280	324
87 ...	175	270	381	16 ...	187	269	349
Average...	184	316	428	Average	169	267	327

The effect on butter fat production has in some cases been equally striking, though this was naturally influenced very largely by the condition of the cows before the lick was administered. In some cases on affected blocks the cows retained their condition and milked well without lick. In these cases the effect of the lick was naturally not so striking as it was where the cows were in poor condition and consequently giving little milk. One settler during the year September, 1932, to August, 1933, sent to the butter factory 2,962 lbs. of butter fat from 13 cows. During the following twelve months Denmark Lick No. 1 was administered and 4,001 lbs. of butter fat was sent to the factory from the same number of cows, an increase of 1,039 lbs., or an average increase of 6.7 lbs. per cow per month.

The following table shows the increase which has occurred on properties where Denmark Lick No. 1 was fed for the first time this year. In all cases some at least of the cows were in poor condition during the months July to September, 1933. The figures represent the number of pounds of butter fat sent to the factory.

—July to September, 1933.—		—July to September, 1934.—	
Total Fat.	Fat per Cow per month.	Total Fat.	Fat per Cow per month.
lbs.	lbs.	lbs.	lbs.
95	6.3	91	15.2
185	9.8	458	16.3
626	16.9	934	22.3
464	15.4	723	24.1
364	17.5	855	21.9
93	7.1	398	16.6
84	9.3	329	18.3
58	8.3	469	20.4

In some cases it has been noticed that the lick is not being fed systematically. It is given at irregular intervals to affected animals and when these have improved in condition its administration is stopped. The best results cannot be obtained in this way. The lick should not be regarded as medicine but as part of the animals' food and should therefore be given regularly to all animals in the following quantities:—1 week to 6 months, $\frac{1}{2}$ ounce twice daily; 6 to 12 months, 1 ounce twice daily; over 12 months, $1\frac{1}{2}$ ounces twice daily. Putting the lick out in boxes is wasteful and uncertain and best results will be obtained by bailing all animals and giving the correct quantities in milk or dry feed.

“THE JOURNAL OF AGRICULTURE”

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SUBTERRANEAN CLOVER.

New Strains from Northam and Muresk.

A. B. ADAMS, B.Sc. (Agric.), Muresk Agricultural College.

An apparently distinctly new strain of Subterranean Clover was noticed on the roadside at Northam in early September, and another, first seen two years ago, but temporarily lost, was rediscovered on the railway line at Muresk by one of the students. Still another very late strain was found by two of the students on the rich moist soil of the banks of Spencer's Brook, close to its junction with the Avon.

Tentatively, it is proposed to name these new strains: Muresk Early, Northam Midseason, Spencer's Brook Late.

Muresk Early.—Commences to flower early in August.

Description.—Differs from Dwalganup Early in the shape of the leaflet, and in the white crescent, which is more distinct and has less tendency to disappear in older plants. The calyx tube green with slight stippling of red at base of teeth, and teeth red.

Northam Midseason.—Commences to flower about the first week in September, approximately a fortnight later than Daliak Second Early, and a fortnight before Midseason.

Description.—Calyx pale green. Stipules green veins on white background. Leaflets have a distinct crescent mark that is almost white (in Midseason the mark is a pale green) extending to the outer edge of the leaflet. Over the midrib the mark is pale green similar to the mark in Midseason, and this is continued on each side by lighter crescentic marks to the margin of the leaf.

It has larger leaves and thicker stems than any of the early or second early strains.

Spencer's Brook Late.—Commences to flower about last week in October, later than Wenigup, as this flowers early October at Muresk.

Description.—Calyx pale green with green teeth. Stipules pointed as in Wenigup Late. Leaves very large with light crescent mark to margin of leaflets.

Shape of Leaflet in above Varieties.—It was noticed by the writer that the shape of the leaflet is a character of some importance in distinguishing the different varieties.

Illustrations are required to show all the differences in shape and markings. It is hoped that it will be possible to do this next season; in the meantime, the following are some examples of observed differences:—

Dwalganup Early.—Leaflet without, or almost without notch at apex; sides of leaflet rounded (between Midseason and straight sided wedge-shaped strains).

Midseason.—Notch at apex; sides of leaflet almost semi-circular.

Daliak.—Deep notch at apex; sides of leaflet so straight as to give an almost triangular or wedge-shaped appearance.

Of the new varieties or strains now described, the *Muresk Early* and *Northam Midseason* have the wedge-shaped type of leaflet. *Spencer's Brook Late* is rather rounded, but less so than *Midseason*. They all have the notch in the apex of the leaflet.

GENERAL MANAGEMENT OF SHEEP.

By HUGH MCCALLUM, Sheep and Wool Inspector,
and

W. McC. JOHNSON, Cadet.

In dealing generally with a subject as comprehensive as the sheep industry, this article must necessarily be confined to brief references to main points of interest, any of which could quite easily be made the subject of an article in itself.

It will be generally admitted that the co-operation between the farming community and the Department of Agriculture is increasing every day, and the exchange of information has been of great benefit, and will be of greater benefit still. There are many important events that happen during the year amongst farmers which, if properly tabulated and inquired into, would solve many problems in sheep breeding. Sheep on the farm are necessary to enable the farmer to obtain the highest possible returns. Therefore they take a definite part in the production of crops.

Our State can become within a few years a very large producer of sheep and wool, but there will have to be changes in the methods of sheep breeding by many sheep owners, who do not conduct breeding as business men. We must try to produce a better type of sheep. Whilst the improvement in breeding is one of the main objects to be attained, the question of losses through neglect, incorrect feeding and other causes must be carefully studied, and means adopted successfully to combat them. Overstocking and under-feeding are out-standing faults of management and should not occur in this State, where reserves of feed can be conserved. A farmer should know the carrying capacity of the farm and stock accordingly. It is not numbers that count, but quality in sheep husbandry. The farmer should decide what type of sheep is most suitable for his district. To the beginner on the wheat lands merino sheep are recommended. They should be of good constitution and conformation, large-framed and growing fleeces of good commercial value. As production is the main factor in sheep breeding, watch carefully that the flocks do not go back and lose their former vigour through the introduction of the wrong type of rams. There are rules to be observed by every farmer in sheep breeding, and one of the most important is not to breed from extremes, a practice which has unfortunately been followed by many breeders.

Our Agricultural Shows have done much to assist the sheep farmer, and instruction is now better disseminated. Whilst good progress has been shown in this industry there is still much to learn, not only by the ordinary farmer, but also by the more progressive man. The improvement of the flocks requires much patience and perseverance, and a fixed idea in one's mind of the object to be attained. The farmer should become a good judge so as to notice the bad, as well as the good points in sheep. He must know his flock intimately and what he wants and what he must cull from the flock. The farmer who fulfils these requirements can accurately describe the kind of rams required for his flock. The more you look after the flock the stronger and healthier will be the offspring, and they, remember, are the future flock. Keeping sheep clean before and after lambing is very necessary. Change them to different pastures, also give them the elements that are deficient in the soils by means of licks, etc. These add to the general health of the flock.

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Selecting the Rams.

The important business of selecting suitable rams to mate with the ewes calls for attention. In doing this, the general character of the flock must be borne in mind and also the faults and blemishes that must be eradicated as far as possible in the next generation, and to this end the rams purchased should be exceptionally strong in those points where the ewes are faulty, otherwise the results will not be very satisfactory. Carefully observe the important points of good quality, pure breeding and good constitution. These qualities a ram must possess, along with as much style and finish as it is possible to obtain. It is on the ram that so much depends as regards the quality of the future flock. It is essential to examine closely the way the animal stands. Some rams stand square on their feet; others are very faulty, and notice should be taken to see whether there is any inclination to weakness in the hocks and hind legs. Straight hocks and good action are outstanding points of a well-bred ram.

Selecting the Breeding Ewes.

Often the farmer does not realise the importance of the ewes in building up a flock to the ideal aimed at by the breeder. They should be carefully selected for their requisite qualities. Leading characteristics which ewes should possess are constitution, conformation, trueness to type, vitality and fertility. With sound vitality the ewes can stand reverses, but should be looked after, especially during gestation and at lambing time. Fertility is essential. No ewe that has failed to produce lambs should be kept on the farm. There are too many unproductive ewes retained, year after year, for reasons difficult to understand. Good lines of cast for age ewes can be purchased off shears. They are generally a very even line, having been retained by the breeder for several years. Each season after shearing the older sheep are sold, the younger ewes taking their place. These sheep can be recommended, and providing they receive fair treatment will, when mated to rams of quality, produce high-grade sheep. Most of the good flocks pastured on the wheat lands were bred from cast for age ewes.

Broken-mouthed sheep, even though they are cheap, should never be purchased. It is wise not to bargain unduly over the price required by the vendor of good sheep. Bear in mind the time, cost and work involved in breeding a uniform flock. By starting on sound lines many years of unprofitable work in selecting, mating, breeding and culling are saved, besides the usual disappointments the stud breeders experience. Success or failure will depend entirely on the farmer's own ability.

Both the rams and ewes should be in good condition before mating. Sheep that are poor throughout the year, cannot produce good lambs, and under these conditions the percentage is always low. The offspring never get a chance to develop into sheep which compare with flocks that are fed evenly throughout the year.

Culling the Flock.

Before shearing every year the flock should be classed with the exception of the lambs. The object of classing is to remove all the undesirable sheep that do not come up to a certain standard. The average farmer can, with a little judgment, cull many sheep from the flock that are unprofitable to retain. The percentage of rejects will greatly depend on the standard of excellence set in the flock. As the flock improves, the percentage lowers and the quality of the rejects is higher. The unprofitable sheep should be fattened and sold.

Lambing Season.

The number of lambs raised largely depends upon the care given by the breeder to the flock during the lambing period. The points to be remembered by him are constant daily attention to the ewes and looking after the new born lambs insufficiently strong to help themselves.

Undulating country is the best for lambing. It enables the ewes and lambs to escape exposure to cold winds. Shade and shelter are also a benefit. The increased number of lambs and the value of the sheep will repay the extra care during the lambing season.

Lamb Marking.

The safest time for lamb marking is cool dry weather. The lambs should not be driven fast before or after the operation. If this is done losses from bleeding will be far more likely to occur. Cleanliness should always be studied. Knives and other implements used should be constantly sterilised by dipping in a good antiseptic, and the ewes and lambs returned to the pastures as soon as the lambs are mothered.

Weaning the Lambs.

Allow the lambs as long as possible with their mothers and always reserve a paddock to receive the weaners, spelling it for some time previously. They should have a paddock with the greatest variety of feed. It is necessary that the young sheep should keep developing, as they never rightly recover if once they receive a set back. When separating the lambs from their mothers do not leave them entirely alone. A few dry ewes with the weaners will steady them down.

Tick and Lice.

This is a matter of vital importance to the sheep industry which every farmer must recognise. He should be constantly on the alert to see that the flocks are free from infestation. The value of dipping is considerable. Wool free from tick naturally brings higher prices than when infested with parasites.

Combating the Blow-fly.

The blow-fly pest, which annually involves breeders in heavy losses, has long since become a source of serious trouble to the sheep industry. Some years the mortality is much greater than others, due largely to more favourable weather conditions for the breeding of flies. Just before lambing time and during the wet season is the most dangerous period of the year. Breeders should watch the flock for any sheep affected and attend to same at once. A good method of prevention of the trouble is to crutch all the sheep by removing from the hind parts all stained wool, and apply dressings for prevention.

Maintenance.

Every effort should be made each year in some way to improve production, otherwise deterioration will set in, and if neglected, will increase every year. The farmer cannot expect to take everything from the land without returning a portion of what he has taken out, in some form or another. Besides a utility shed for shearing, there should be good yards with a drafting race. This will save considerable time and money, the cost of which will be repaid in two or three seasons.

SUBTERRANEAN CLOVER.

Response of Different Strains to Seasonal Conditions.

A. B. ADAMS,

Muresk Agricultural College.

The season 1934 has been unusual, as there was sufficient rain in March at Muresk to germinate clover seed, followed by rains that kept the plants growing. Usually, the first useful rains are in May, and this seasonal difference has afforded an opportunity to observe the effect of the difference on the time of flowering of various strains of Subterranean Clover.

The early strains were stimulated into earlier flowering than usual; Dwalganup Extra Early and Burlong (Northam First) Early produced some flowers at the end of June, and were flowering prolifically in July. Their earliest flowering time in a normal season is during the first week of August.

The later strains as Daliak and mid-season made little, if any, response to the early rains, in the way of earlier flower production, although they made more leaf growth than usual during early winter. Daliak commenced flowering about the third week in August and midseason three weeks to a month later. These are the usual flowering dates for these varieties.

It is suggested as a possibility that the earlier varieties are short day plants, or at least do not need a long day in order to produce flowers, and that the later varieties require a certain length of day before flower buds are formed.

The time of flowering of the early varieties in our conditions is regulated by the time of the first useful rains, i.e., time of germination, but in the case of the later varieties, by the amount of daylight.

DAIRY CATTLE IMPROVEMENT ACT, 1922, AND AMENDMENT ACT, 1932.

Registration of Bulls.

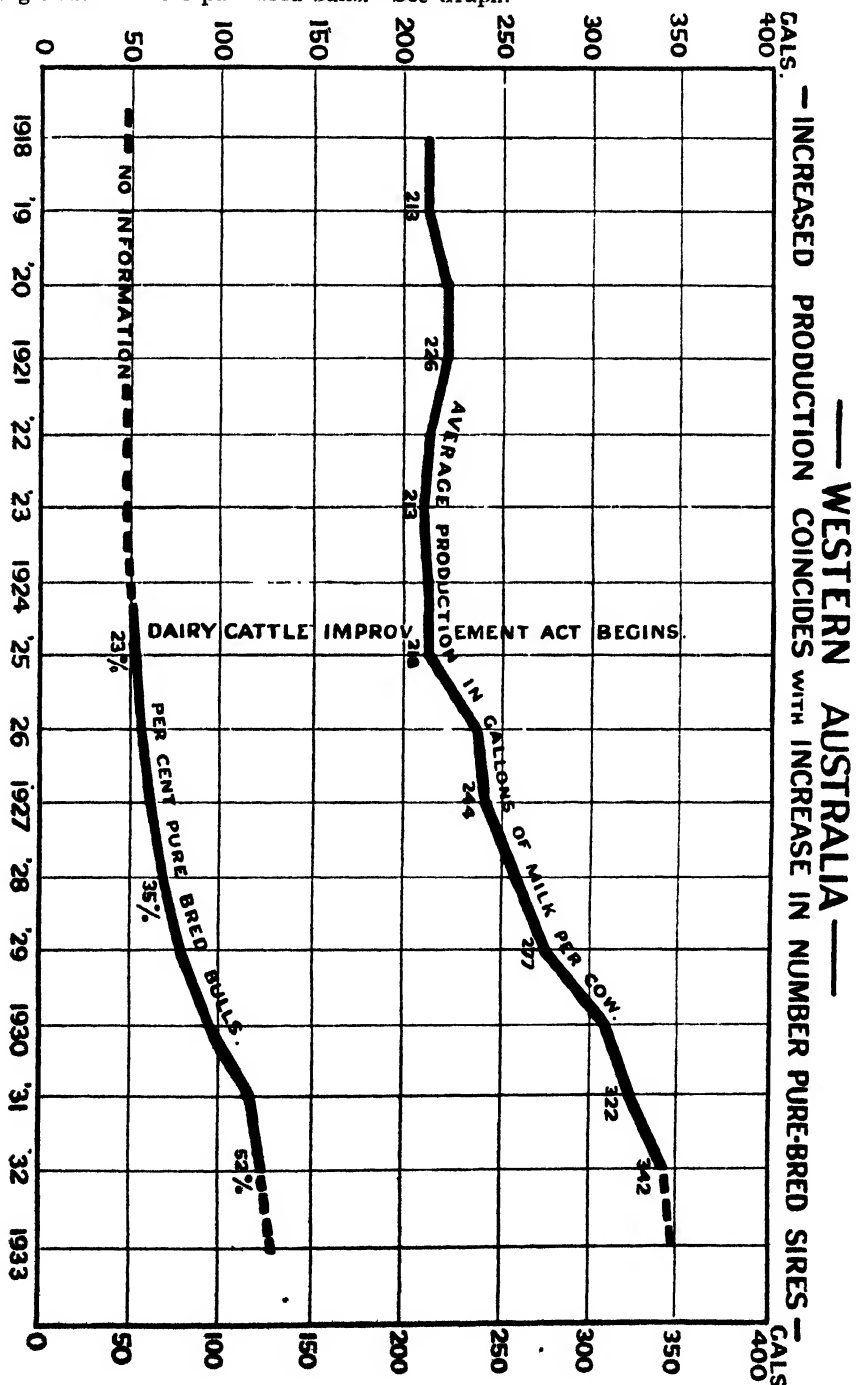
G. K. BARON-HAY,

Superintendent of Dairying, Department of Agriculture.

With present world prices for butter-fat as they are and indications that, perhaps not immediately but at some not far distant date, dairy farmers in Western Australia may be forced to accept prices for their dairy produce more in conformity with those in the Eastern States owing to the increased production, it is of more importance than ever before that the average production of cows in the herds should be increased. The results obtained from the testing of cows in 1933 under the Grade Herd Recording Scheme, showed that the 4,000 cows tested averaged 181 lbs. butter-fat in comparison with 140 lbs. which is the State average.

It was also most striking that the higher averages were secured by those herds where the use of pure-bred sires ex-tested dams had been the policy of the owner for a number of years. The number of pure-bred bulls owned by farmers testing under the scheme was approximately 70 per cent., in comparison with only 56 per cent. for the State.

This latter figure, however, is a great improvement on that which obtained when the registration was first enforced in 1925, when only 23 per cent. of the registrations were pure-bred bulls. See Graph.



The enforcement of the Act, therefore, is not a hardship to those farmers who are endeavouring to improve their stock, and as assistance is given by means of the Subsidy Scheme for the replacement of undesirable bulls by herd-book registered animals from high-producing females, no farmer should complain against the administration of the Act requiring the registration of the dairy sire.

In the case of pure-bred bulls, registration is for life, the fee being 10s. per head, whilst grade bulls must be registered annually, the fee being 5s. for each application.

Farmers are reminded that registrations are due on the 1st January, 1935, each year in the case of grade bulls and on the same date for pure-bred bulls which must be registered for life. Information regarding transfers, de-sexing, or slaughter of any registered bulls should be forwarded to the Department immediately, particularly in the case of life-registered animals, in order that the records may be kept complete.

LEMON CURING.

GEO. W. WICKENS,

Superintendent of Horticulture, Department of Agriculture.

PICKING.

Gather the fruit when it reaches a diameter of $2\frac{1}{2}$ inches, and while still green or yellowish green. Do not store fruit which is fully yellow and tree ripe.

Each lemon should be clipped (not pulled) from the tree in such a manner as not to remove the "button," and this can best be done by making two cuts—one when severing the fruit from the branch and another shortening the stem to about one-eighth inch in length before placing in picking box. Great care must be exercised when picking to prevent injury to the skin of the fruit, any abrasion of which is almost certain to result in mould infection.

Do not tip the fruit from a picking box into a sweat box, but handle each fruit separately throughout the operation of gathering and storing; best results will be obtained if the pickers use gloves and the picking boxes are padded.

No lemons should be stored which show skin blemishes from limb rubs, thorns, etc.

SWEATING.

After the fruit is gathered it should be placed loosely in boxes—petrol cases are suitable—and stacked in a well-ventilated shed from three to seven days according to weather conditions being dry or damp, so as to allow the fruit to dry off, i.e., "sweat."

STORING.

When sweating is completed, the fruit can be stored for curing in several ways, according to the number to be treated and the facilities the grower is able to afford.

Method No. 1.—Wrap each fruit in sulphite tissue paper—apple wraps—and pack loosely in cases lined with paper at bottom and sides and doubled over the top. Stack in a cool dark shed which must not be draughty. If shed cannot be darkened and draughts eliminated, cover the stacks of fruit with canvas sheets or hags, and during the early period of storage raise same occasionally at night,

preventing, as far as possible, great variations in temperature and humidity. Examine the fruit 14 days after storage, removing any showing signs of mould. This can be discerned without unwrapping the lemons. Examine again at later periods, the time of which will vary according to condition of fruit, but if it has been handled with care throughout, very little decay should be found.

Method No. 2.—After sweating, wrap each fruit in sulphite tissue paper. Line the storage cases with paper and pack fruit loosely in these, using chaff as a filler as follows:—Just cover the bottom of the case with a layer of chaff, place thereon a layer of lemons; then fill spaces between and cover fruit with a further layer of chaff; then another layer of lemons, and so on until case is filled. Stack, handle and examine in shed same as advised for cases packed without chaff.

Method No. 3.—After sweating, place the fruit loosely and unwrapped in storage cases lined with paper. Stack cases in shed free from draughts in blocks of 40 to 50 and cover these with canvas tents. Place a dish of water inside each tent, thus maintaining humidity and preventing excessive shrinkage by evaporation of fruit. If drops of moisture appear on surface of fruit, raise the sides of the tents until these have disappeared; then drop again into position. Examine the fruit periodically for mould infection.

Method No. 4.—Underground cellars, if properly constructed, make satisfactory storage places, but require careful attention in preventing moisture from oozing through, or collecting on the walls and floor during winter rains, and an air circulation which will allow of gases given off from the fruit being carried out of the chamber must be provided.

Finally it must be remembered that no matter what method of storage is adopted, none will be successful if the fruit has been bruised or the skins scratched. Gathering the fruit at the right time and avoiding skin injury are essentials in successful lemon curing.

VERMIN POISONING.

A. ARNOLD, Chief Inspector of Rabbits.

G. HERBERT, Trapper, Vermin Advisory Board.

VALUE OF POISONING.

In dealing with the destruction of vermin of all kinds, it is well to know that poisoning is the most efficient method to employ. This applies to dogs and foxes equally as to all other vermin, and no district can be effectively cleared of these pests without prolific use of poisoned baits.

Trapping, hunting, shooting and other methods, although of great value, usually provide only temporary relief, but the silent and deadly method of distributing poisoned baits all the year round must eventually bring about definite and lasting results. It also has the added value of not interfering with any other method employed.

Poisoning should be regarded as a first line of defence, to be continuously carried out all the year round over a wide area. Further, poisoning is a very useful ally of trapping, and should be used in conjunction with it, particularly in new country. Settlers who suffer from dingo attacks, in addition to using traps intelligently, and therefore efficiently, should acquire the poison habit as applied to dingoes, foxes and eagle hawks. After poisoning has been carried out, trapping may be employed as a second line of attack.

Many trappers ridicule the idea of poison being used, but it is very significant that it is extremely difficult to persuade a trapper to operate in a well-poisoned district. In such districts these men often spend a lot of time and trouble setting traps only to find that the animal or animals they are after have disappeared. Very often the carcass of the animal is found weeks, or even months, after it has disappeared, as the result of being laid low by a bait. Many are never found; in fact, even under the most favourable circumstances, if 30 per cent. of poisoned animals are located, it is considered a good average, while in heavily timbered or rough scrub country, 15 per cent. would be a fair proportion even for the most optimistic and skilful poisoner.

STRYCHNINE.

There are several important features connected with poisoning not sufficiently well known by those who use or intend to use this method for eradicating vermin. These are: firstly, the most suitable poison to use; secondly, how to apply it; and finally, the size of the dose in order to obtain the most satisfactory result.

Strychnine is considered the best poison to use for dingoes, foxes and eagle hawks. It is rapid in its action and does not deteriorate, so that, whilst the bait poisoned with strychnine remains intact, it is still effective.

When using strychnine, however, it is well to remember that it is a deadly poison and certain precautions should be observed. It should not be removed from the original container in which it is received, except for immediate use, but if for any reason this is necessary the new container into which it is placed should immediately be labelled. Where any measure is used, it should be thoroughly cleaned immediately after use. The observance of these precautions may appear to be unnecessary, but may avert a tragedy.

Strychnine is sold either as free strychnine or in combination with an acid. The forms resulting from the combination of strychnine with an acid are known as the salts of strychnine and are sold in the trade under their special names, such as strychnine sulphate, etc. These are regarded as soluble strychnine. The free strychnine is known in the trade as "alkaloid" strychnine and is practically insoluble. The alkaloid is the form recommended for vermin destruction and especially for dogs and foxes. The free strychnine is only slightly soluble in water (1 part of strychnine dissolving in 6,000 parts of water) and may be called insoluble strychnine. The strychnine salts have solubilities from 1 in 40 to 1 in 70, and are often referred to as the soluble strychnines. As manufactured, free strychnine is in the form of large crystals, while the salts form crystals so small that they are often referred to as "powdered" strychnine. Since grinding the crystals to powder does not change the composition or solubility, this method of distinguishing between free strychnine and its salts is unreliable and likely to lead to some confusion, as manufacturers are sometimes requested to grind the crystals before sending them to Vermin Boards.

If it is desired to know whether certain strychnine is strychnine salt or powdered crystals, the best test is to place a small quantity in a test tube or similar small container of water. This should be left overnight, and if it is then found to be dissolved in the water, it is strychnine salt.

In this article, where "powdered form" is used, strychnine salts are meant and not fine-crushed crystals.

Both forms are prepared in two colours, red and white. The natural colour is white, the red colouring being added as a precaution for safety purposes, and to prevent its being used as a baking powder, etc. The colouring has no effect on the toxic properties of the strychnine, and the coloured forms should always be used; the prejudice against it being entirely unwarranted. Strychnine is usually put up in 1 ounce bottles or containers, the crystal form being a smaller package and, bulk for bulk, is 20 per cent. more deadly than the powdered form. Because of this it is necessary to add a little more per bait than when the crystal form is used. When the crystal form is used it is a good plan to grind up the crystals to avoid the possibility of their falling out of the bait. This can easily be done by crushing the material against the side of the containers with a knife.

ACTION OF STRYCHNINE.

Strychnine in both forms is readily dissolved by an acid, and the acid of the gastric juices in the stomach dissolves the strychnine, which is absorbed by the system, thus causing death. The first effect is to cause a vomiting sensation in the stomach. Some are of the opinion that a little bi-carbonate of soda (baking soda) added to the strychnine quickens its action, causing the animal to die close at hand, but the addition of soda would, if anything, tend to delay the action of the strychnine, because its effect would be to temporarily neutralise the acid in the stomach so necessary to dissolve the drug. Once this neutralising action was overcome, however, the strychnine would do its work. Possibly, the soda, through its settling action on the stomach, would prevent the animal from vomiting.

Strychnine is very bitter to the taste, and if raw meat or liver is used, the acid in this type of bait will render some of the strychnine soluble. In consequence, the animal will be able to taste the poison, and this will often cause it to drop the bait. Here again the soda would possibly be of value by neutralising the acid effect. In cooked baits, or baits of fat, suet or an oily nature, where no acid action exists, it would be of no value. For those who desire to use soda it may be stated that half an ounce of soda to one ounce of strychnine is the correct mixture.

After swallowing a bait, a dog or fox will often travel a long way before the strychnine takes effect. It has been noted, as the result of a post mortem, that whenever this has happened the animal always had more food in the stomach than was supplied by the bait. The strychnine does not come into contact with the gastric juices of the stomach till the digestive organs assimilate the bait. If, therefore, other food is eaten before the bait is taken, the latter will remain intact and the strychnine lie dormant till the former is digested. An animal with a full stomach may live for some hours, and travel some distance before the strychnine does its work. When this happens, it will be found that the animal dies very shortly after the strychnine takes effect. It is the animal which vomits shortly after taking a bait which recovers. With dogs and foxes, the first indication of the strychnine operating is a dragging of the hind legs, with a staggering gait, followed by a fit. One may be sure when this happens the carcass of the animal is not very far off. A drink of water often has a hastening effect, hence the value of poisoning near watering places.

TOXIC DOSE.

It is not an easy matter to state definitely the toxic dose of strychnine for any animal, as the action will vary according to its size and condition. An empty stomach, a young animal or one in a weakened condition, all offer conditions fav-

ourable to quick action. Dogs are particularly susceptible too, and are easily affected by strychnine. The recognised toxic dose for a dog the size of a dingo is one-third of a grain of strychnine, i.e., strychnine without admixture of soda, etc.; this amount when finely ground up, will just cover half an inch of the small blade of an ordinary pocket knife, or as much as will cover a threepenny piece thinly. If the strychnine is heaped up on the threepenny piece so that it holds as much as possible, the weight is three grains or enough to poison nine dogs.

In using the sulphate or powdered form, or ground crystals, with soda added, it is necessary to increase the dose, say, as much as would comfortably lie on three-quarters of an inch of the knife blade. It is possible to err on the side of giving too small a dose, when the animal will recover and live to remember the pain suffered and refuse baits. On the other hand, many trappers, taught by practical experience, declare that an over-dose cannot be given. Possibly this is incorrect, but it is evidently better to be liberal with the quantity given to ensure that the animal will receive sufficient to kill it.

TYPE OF BAIT.

With regard to baits, one must be guided to a large extent by the natural conditions in the locality. For instance, if a dog's natural food is mainly kangaroo, it has been found that poisoned emu baits will be more readily taken. Experience has proved that good results are obtained from baits composed of mutton, suet, fat, pork, brains, kidney, liver, fish, sardines and sardine tins with oil in them. Flesh of any kind can be used and cooked meat frequently makes a better bait than fresh meat. Birds such as parrots, etc., are an excellent bait for foxes; the heads of turkeys and fowls which have been killed for domestic use are also very good.

For general use, however, suet or fat has many advantages over any other type of bait. In the first place, because both the dog and fox are fond of fat, owing to its scarcity in bush game; secondly, because it does not deteriorate as readily as meat or liver (in fact, in cool weather, or if placed in shady places in hot weather, it will keep for quite a long time); and thirdly, owing to the fact that strychnine is very bitter to the taste and readily dissolved by an acid, when meat is used, as previously mentioned, the acid juices contained in the meat may dissolve the strychnine and enable it to be tasted by the animal, causing it to drop the bait. This does not occur with suet or fat, the strychnine remaining in its original form, and, if the bait is carefully prepared as described later, it will be readily taken and swallowed. A further decided advantage of fat baits is that they rarely attract ants. Ants will readily attack meat and even though they will leave it after a time, or at night, the smell or the ants remains on the bait. Both the dog and fox hate the smell of ants, and this is often the reason why baits are left untouched. Ants are not fond of anything oily or greasy, and will do little if any harm to fat or suet baits. This also applies to fat or butter used in tins, also to fat baits rolled in paper. Ants are amongst the worst enemies the vermin poisoner has to contend with, and it will be readily understood why the suet bait is so favoured by him.

PREPARATION OF BAITS.

In preparing baits it is important to realise that the smaller the bait—provided it is large enough to hold a good dose of strychnine—the better it will be. A small bait is not only more readily taken than a large one, but it ensures the animal getting sufficient poison to destroy it. A bait about the size of the top joint of a man's thumb is ample for this, and the material used for baits should be cut

accordingly. A deep incision should be made in the bait and the strychnine inserted, taking care not to leave any on the outside. If liver or meat is to be used, it is better to cook it sufficiently to harden it.

After making baits it is a good plan to dip them in melted fats. To do this impale the bait on a stick, or piece of wire, dip it in the fat, draw it out, and then hold it in the air to cool. After dipping two or three times in this way the fat will form a coating over the bait. This helps to preserve the bait, making it more tasty and seals the cut. Another method of making the bait attractive is to slightly roast it over a fire. Whilst referring to fires, it may be stated that dogs and foxes frequent spots where camp fires have been, either to gather up what might have been burnt or after game, also seeking food. Therefore, these places should receive attention for poisoning.

Dripping is another good medium for conveying poisons; 1 oz. of strychnine will poison 12 lbs. of dripping. The strychnine should be stirred into and thoroughly mixed with the dripping whilst in a melted and liquid state. A dessert-spoonful of the poisoned dripping placed on paper either left loosely or wrapped up and placed along the trail or beneath leaves or grass, or left in tins around old camping places and waterholes, will very often prove effective. Handle the baits as little as possible. This, however, is not so important as many people think, as the sun, wind and rain will have their effect and remove any slight smell of handling in a few days.

CARCASE POISONING.

A common method, employed particularly by farmers in the wheat belt, is to insert strychnine in a carcase of a sheep killed by dogs or foxes by making knife cuts in the flesh and working strychnine into these cuts. Sometimes this is successful, but more often than not no result is obtained, and such farmers condemn poisoning as useless. They are not aware of the fact that once an animal becomes a killer he acquires a taste for warm flesh of his own kill; therefore, he is a very difficult animal to poison on his hunting ground. When he enters a paddock he does so with a definite purpose in view, that is, to kill and afterwards to satisfy his hunger from the carcase of the sheep he has attacked. If, therefore, live sheep are available he will not trouble the carcase of a previous kill. He does not, as a rule, remain in the paddock any length of time, but after completing his ruthless slaughter, returns to the safety of the surrounding bush, which is his natural haunt.

Under these conditions, carcase poisoning is therefore of little if any value. It also has other disadvantages. It takes a large quantity of strychnine to effectively poison a carcase, which really provides a large quantity of food which is not required. Often an animal tastes the strychnine which causes him to eat away from the poisoned part. By doing this, he obtains insufficient strychnine to kill, together with a considerable portion of the meat; this will probably cause him to vomit, thus getting rid of the strychnine and allowing him to escape. These are some of the reasons why carcase poisoning does not obtain the result desired. In the event of carcase poisoning being adopted it is better not to smear the strychnine thinly in a long cut, but to make small holes in various parts of the carcase, inserting a good dose of poison in each hole. If the animal eats this particular portion he will receive sufficient poison to destroy him. Further, when a carcase is poisoned it is a wise plan to use the additional method of distributing a number of small baits around the carcase, for a dog will often take a small bait more readily than a large one, and if he swallows a small, well-poisoned bait, he will surely die, even if he eats a large quantity of food before the poison has time to take effect.

WHEN TO POISON.

The question naturally arises, when should poison baits be laid? The obvious reply is whenever the vermin appears. This is quite in order so far as the individual application is concerned, but collective or wholesale poisoning, as would be undertaken at the instigation of the Vermin Board, say, for foxes, is best carried out at certain periods of the year. For instance, it is more important for sheep breeders that a concerted attack be launched against the pest in March, before the lambing season commences. If wholesale poisoning is undertaken an immeasurable amount of good will undoubtedly result, and the Board that organises a systematic attack, and ensures that its instructions are carried out generally throughout its area, can be assured that the losses of lambs from foxes will be materially minimised.

Then there is the mating and breeding season from May onwards. Early pups commence to arrive in July in a normal season and are caught up to the end of the year. For the greater portion of the year the main objective of both the dog and fox is self preservation. His mind and whole being is governed by this instinct, but during the mating season his attention is diverted. Soon after the early rains he commences to move about. There is the seeking of a mate and rivals to combat. A little later there is not so much travelling. A settling down and change of habits takes place. The vermin are then usually running in pairs, the female carrying young and not so alert from a hunting point of view, and therefore more likely to feel the cravings of hunger and more readily to pick up baits, in which case the litter is never born. It is more than probable also that its mate will hang around and will also fall a victim to baits, if plenty are laid. When the young come along there is continuous hunting to provide for them; full advantage should be taken, therefore, of the varying conditions, and any co-operative effort will give best results if launched during these periods, and particularly when the young are roaming about together.

Never lose sight of the fact that a dog or fox is always on the lookout for danger. Instinct, example and experience all tend to make him suspicious of anything unusual and treat it with respect. He always trusts his nose and everything has to be approved by that delicate organ.

The usual breeding places are in rabbit warrens, caves or rocks, hollow logs or trees and thickets. Sometimes they are found under overhanging trees on the banks of rivers, creeks or watercourses, gullies and cliffs or similar protected places. Fox cubs are even found in open sandplain, usually on the side of a slope. The mother will camp on the higher ground above the lair, and, when she detects danger approaching, will slink away along the ridge, in full view for some distance, and finally disappear over it. Evidently her maternal instinct teaches her to draw attention to herself and entice the approaching source of danger away from the lair. Dogs and foxes do not, as a rule, camp with their young, but visit them night and morning to give them food and drink. In the outback areas it is common for dogs to "box" their litters, particularly young sluts with their first litters; that is, to camp all their pups in the one place. As many as five litters have been found mixed together in this way, the pups varying in age from a few weeks to three months. Pups are seldom found more than two miles from a good supply of water, and in the dry areas outback are usually easy to locate for this reason.

WHERE TO LAY BAITS.

In selecting places to lay baits one must be guided to a large extent by the tracks of the animal. Speaking generally, baits should be laid along their definite routes of travel, in the location of which it should be remembered both dogs

and foxes naturally take full advantage of cover and follow creeks, gullies, along old roads, tracks, pads, etc., also around old camping grounds, waterholes and old carcasses, or indeed in any place frequently visited by the dogs or foxes. In large open pastoral areas it is necessary to lay baits for miles outside of the run, for by this means the young and inexperienced animals are cleared out and dealt with before they come in on to the holding. Their feed under natural conditions is less easily obtained than when amongst the flocks, and baits are therefore more readily taken.

TRAILS AND DEPOTS.

An excellent plan for systematic poisoning is to drag a trail through the area to be poisoned, leaving a scent which a dog or fox will invariably follow from mere curiosity or from sheer hunger. The best type of trail to draw is a sheep's paunch or the carcass of a kangaroo or emu, the fatter the better. Some prefer charring or singeing the flesh. This gives it an odour which is attractive, and has the tendency to bring the fats to the surfaces, and fats, besides being particularly appreciated by both dogs and foxes, tend to give body to the scent and prevent loss of the scent from exposure or rain. It is not suggested that anything of a "decoy" nature should be added to the trail. Many are inclined to add aniseed and other strong smelling decoctions, which, though they are perhaps useful to draw a dog's attention to lure him into a trap, are best left alone where baits are concerned. A strange smell, especially on meat, is immediately conveyed to the dog and everything must be approved by his sensitive nose; any other than the natural smell would indicate danger and be left alone. For this reason strong smelling drugs or decoys are to be avoided.

After the trail has been laid, baits of a tempting nature and inviting odour should be laid at intervals of about 100 yards, and, where foxes are prevalent, and the trail is dragged through sandy country, the baits may be buried just under the surface, and the trail again dragged over the buried baits. The foxes follow and dig the baits up.

Another good plan in connection with laying baits is known as the depot method. Under this method a suitable site is selected and made a depot for carcasses, bones and other rubbish. It is stated that by placing a carcass or a few bones at the site and adding to these from time to time they will form an attraction to vermin and, if a liberal dose of small baits is laid round this depot from time to time, this method is very effective. The top of a hill, old camping grounds, soaks or watering places are the most suitable sites to form depots. In the inland pastoral and desert areas excellent results from this method have been obtained by simply shooting a kangaroo here and there, and placing the carcass near a waterhole, soak or other likely place to start the depot. Other food matter can be added occasionally and, after the animals have formed the habit of visiting these places, both poisoned baits and traps can be used with great success. This method has much to recommend it. A settler can concentrate on certain spots in his locality, where there is little chance of doing harm either to his own or other people's animals. By guarding these spots, which may be termed "danger zones," a settler can effectively and efficiently guard his livestock from the depredations of the dog and fox, and save himself both time and expense by obviating the necessity of working throughout the surrounding country.

FOX POISONING.

The increase of the fox in Western Australia is the subject of a good deal of discussion, and many people are of the opinion that they do more good than harm. In some districts, where sheep farming is extensively conducted, there are

Vermin Boards who have asked that the bonus on foxes be discontinued, and the amount thus saved added to the wild-dog bonus. They consider that the destruction caused by foxes amongst poultry and lambs is more than compensated for by the value of their assistance in destroying rabbits, of which they undoubtedly take a heavy toll for many months of the year. There are others, however, who consider that the day is past for giving the fox the benefit of the doubt. The fact remains, foxes are very destructive once they acquire a taste for lambs, and pastoralists must deal with them to protect their flocks.

The haunts of the fox are to be found around the thickly wooded cover adjacent to rivers, creeks, swamps, lagoons, or in boulder-strewn country, where there is plenty of protective cover and along ridges frequented as a lookout, and especially where there is abundance of game, rabbits, etc. They move about mostly at night and live in hollow logs, crevices, between rocks, and such-like places. These are the places to lay baits. Foxes are not difficult to poison if care is taken in the preparation of baits. Baits similar to those prepared for dogs may be used, and in addition to these, birds, especially parrots, are particularly attractive to foxes. If birds are used for baits the poison should be inserted through the beak, making sure it is well down inside. This form of bait is not removed by crows or other birds and will tempt the fox even when dried up.

POISONING EAGLES.

The wedge-tailed eagle, commonly known as the eagle hawk, is the largest and easily the most destructive of all our birds of prey. The average measurements of a normal adult bird are from 7-8 feet span across the wings. Many people mistake several other species of the hawk family for the wedge-tail, particularly in flight, but no one who has had the opportunity to examine an eagle closely should ever mistake any other type of eagle or hawk for this one. It is outstanding in size in every way; body, wings, head and talons are so much larger than any other type, that for this reason alone it is easily recognised. Even the young birds in the nest are abnormally large about the head and feet, much bigger than the average full-grown hawk before they reach the feathered stage. They have other peculiarities as well, but the size alone should be sufficient for the average person to readily recognise the eagle from the other species.

These birds do a great deal more harm than is usually credited to them and in some parts of Western Australia, as well as the Eastern States, are a greater menace to sheep than either the dog or fox. Usually the greatest losses occur during the lambing season, but grown sheep are often attacked by eagles.

Eagles are not prolific breeders. They lay once a year, one egg being the usual clutch, two are somewhat uncommon and three, although not unknown, are exceedingly rare. They invariably lay in or adjacent to the same nest every year, and build their nest in a tree or on a high projecting cliff. Some of these nests are huge affairs, over ten feet across and built of sticks of various sizes, some three or four feet long and two inches in diameter. Their hunting is usually done early in the morning or near sundown, and although they are often about and flying at a considerable height on a cloudy day, the early morning appears to be the eagle's most favoured hunting period.

Unlike the dog and fox, carcass poisoning gives the best results with eagles. It is important, however, always to use small baits on or around a carcass as with dogs and foxes. Trapping is also useful and the eagles may be caught by setting traps around a carcass. As the eagle's method of travelling is by air, the more elevated positions are the most suitable places to poison or trap them, for they

will often alight on a high hilltop, when otherwise they would pass on. A good plan is to select as a site the top of a rise or hill, the higher the better. In open country it is also advisable to place a carcass near a tall tree, if such can be found. The carcass, of course, is the decoy, and the hill top, large rock or tree acting as a secondary measure to entice the bird to the spot. It is also helpful to burn a small area a few chains square at the site, fires and fire-burnt country proving a great attraction for hawks and crows, because a great many of the smaller vermin, such as lizards, snakes, mice, etc., are often destroyed by fire and provide food which is a welcome contribution to their daily fare. Eagles prefer fresh food and old carcasses are of no value for baits.

The method recommended for poisoning or trapping eagles is to secure a freshly killed carcass (do not burn it) and place it at the selected site as late in the evening as possible, leaving it where it can be easily seen. The carcass will then be quite fresh the following morning. Some years ago a station on the Upper Gascoyne was newly converted into sheep country, and the first year from 5,000 mated ewes there were less than 10 per cent. of lambs, due to the depredations of eagles during the lambing season. The station manager obtained a supply of strychnine and, game being plentiful, he toured the surrounding country for some weeks in a motor car, shooting game and poisoning it for eagle hawks throughout his tour. Over 600 eagles were accounted for in a few months and the following year some 80 per cent. lambs were marked. No serious lossess through eagles have occurred on this property since.

Rabbits form the chief diet of the eagle in the wheat belt, but the same argument applies with the eagle as with the dog and fox; once the eagle acquires a taste for fresh killed lambs, he is a menace till he is finally destroyed.

CONTROL OF DOMESTIC DOG.

The control, or perhaps a better term would be the lack of control, of the domestic dog plays a far more important part in vermin infestation than many people realise. The working sheep or cattle dog kept for a useful purpose must of necessity be kept under control, otherwise it soon becomes of little value. This type of animal is an asset not only to its owner, but to a district; not merely for its work alone, but for breeding purposes, and there is always a keen demand for the progeny of these animals in any districts. The trouble arises from the non-descript, ill-bred, usually underfed type of creature which is allowed to roam at will, uncontrolled and uncared for, often forced, through ill-treatment and lack of nourishment, to wander into the bush or on to another person's property to fend for itself. It also occurs in places where settlement has moved on or been abandoned, such as timber workers' camps. In the South-West timber areas and other places, unfortunate dogs are left to fend for themselves as best they can. During the breeding season even well-fed and kindly treated animals answer the call of Nature, and seek a mate in the bush. In this manner many types of cross-breeds are bred, often of a very formidable nature. Any dog, after living for some time in the bush, naturally reverts to a wild state, and by breeding with the wild dogs with which he associates, establishes a breed which becomes a curse and a menace. The Collie, Kangaroo dog and Alsatian establish a particularly ruthless, dangerous, and daring type of animal. So pronounced has the crossbred strain become of later years, particularly in the more settled regions, that the original name "Dingo" is becoming a farce, and the term "wild dog" used in its place.

Although pure-bred dingoes are still to be found, chiefly on the fringe or outside of settlement in the inner areas, the crossbreeds of the near domestic dogs pre-

dominate, and the dingo strain is slowly but surely dying out. These creatures cost Australia many thousands of pounds every year both in bonus payments and losses in sheep and livestock of other kinds. Instances of foals and yearling calves being torn to pieces by several of the more vicious and daring type of crossbreds are not uncommon. Settlers, therefore, would be well advised to keep strict control of their domestic dogs, restrict their breeding to a minimum, and assist their local vermin officers whenever possible in the destruction of stray animals. If this were done, many thousands of pounds would be saved annually. It is little use spending thousands of pounds to eradicate the wild animal, when other dogs, often of a worse type, are being bred and allowed to roam at large to take its place. It takes little of the wild strain to keep the breed going where wandering domestic dogs are numerous, but if efficient control were kept over these, the wild strain would soon cease to exist. Under the existing conditions, however, it will be many years before the wild-dog menace is finally overcome. The problem is a huge but not impossible one, and is essentially a community rather than an individual task, though each individual has his or her own responsibilities. It is necessary, therefore, for all settlers to acquire the poison habit, learn to use traps intelligently and efficiently, and control the domestic dog. When this is done the solution of the problem will be well within sight, and each year bring near the ultimate goal—the extermination of the dog and fox. It will be a wonderful day for Australia when the stock owner can leave his flocks to graze in the pastures and rest assured they will be immune from the attack of the wild dog, the wandering domestic dog and the fox.

DESTRUCTION OF WILD TURNIP SEED IN SECOND-HAND BAGS BY CHEMICAL MEANS.

J. M. ALLAN, B.Sc.Agr. (Hons.), W.A., Assistant Research Officer, Division of Plant Industry, Council for Scientific and Industrial Research.

Of recent years second-hand bags have played an increasingly important part in the spreading of wild turnip (*Brassica Tournesfortii*; *Gouan*) from paddock to paddock, property to property, and from district to district. This is especially so, perhaps, since the advent of bulk handling, where the farmer uses the same bags for collecting the harvest and for holding the next season's seed. Another avenue is where bagged wheat is bulked at the port and the bags are offered for resale.

Where a crop badly infested with wild turnip is harvested, the seeds of the weed are found to be thoroughly intermixed with the wheat grain in the bags. Owing to the small size of the wild turnip seeds, they are readily enmeshed and held between the wheat bag fibres; also the seed coat is of such a nature that it adheres readily to any loose fibres. The outer seed coat is mucilaginous, and when moistened the seeds become quite sticky and firmly glued to the fibres. If clean wheat grain is stored or placed in these bags before or during seeding operations, much of the mechanically held wild turnip seed is scrubbed out by the wheat grain, and, in this way, this serious weed pest may be spread to previously "clean" areas.

During this year the Department was approached by Mr. Rupert Orr, Newdegate, for a means of destroying the seeds enmeshed in the fibres of second-hand bags, so that the bags could be used with safety during seeding operations. It

was thought that the best means of eradication would be one in which the bags were soaked in chemical solutions, which would destroy the germinating power of the seeds. Experiments were initiated, using chemicals that were sufficiently cheap to justify the treatment and that were well known in other aspects of farming practice.

The first experiments were carried out with a parcel of rather old seeds which accounts for the low percentage germination; but the results indicated what treatments were likely to be effective. The second series of experiments was made with a parcel of seed received from Mr. Orr, of which the germination was not particularly high, but the response to chemical treatments was fairly conclusive.

In each section of the experiment about 200 seeds were used. The procedure was to tie them up in small butter muslin bags and immerse in the chemical solution of definite strength for the times as set out in the table below. The seeds were allowed to dry in the bags and then germinated on blotting paper.

RESULTS OF EXPERIMENTS.

1ST SERIES OF EXPERIMENTS—

Treatment.	Percentage Germination.
Untreated	7.3
Water—	
Soaked for 24 hours	13.5
Soaked for 1 week	7.0
Dipped in Boiling Water	0.
Superphosphate Solutions—	
1 lb. super. to 10 gals. water :	
Dipped for 1 hour and dipped in Limewater	22.0
1 lb. super. to 1 gal. water :	
Dipped for 1 hour and dipped in Limewater	28.6
Formalin—	
1 part of Formalin to 320 parts water :	
Soaked for 1 hour	0.
Soaked for 24 hours	0.
2 per cent. Solution :	
Soaked for 1 hour	0.
Soaked for 24 hours	0.
10 per cent. Solution :	
Soaked for 10 minutes	0.
Soaked for 1 hour	0.
Copper Sulphate (Bluestone)—	
1 per cent. Solution :	
Soaked for 1 hour	0.
Soaked for 24 hours	0.
10 per cent. Solution :	
Soaked for 10 minutes	0.
Soaked for 1 hour	0.
Saturated Solution :	
Soaked for 5 minutes	0.
Soaked for 1 hour	0.
Common Salt—	
20 per cent. Solution :	
Soaked for 1 hour and washed in water 1 hour	0.

2ND SERIES OF EXPERIMENTS—

Treatment.	Percentage Germination.
Untreated	27.0
Water—	
Dipped in Boiling Water	0.
Formalin—	
1 part of Formalin to 320 parts water :	
Dipped until wet	9.5
Soaked for 5 minutes	8.5
Soaked for 20 minutes	2.5
2 per cent. Solutions :	
Dipped until wet	9.0
Soaked for 5 minutes	8.5
Soaked for 20 minutes	1.0
Copper Sulphate (Bluestone)—	
1 per cent. Solution :	
Dipped until wet	11.5
Soaked for 5 minutes	12.0
Soaked for 20 minutes	6.0
5 per cent. Solution :	
Soaked for 10 minutes	0.
Soaked for 20 minutes	0.
10 per cent. Solution :	
Soaked for 10 minutes	0.

In the boiling water treatment the muslin bag of seeds was dipped in until thoroughly wetted, then allowed to dry. After the superphosphate solutions it was necessary to dip the bags into lime water to neutralise the acidity of the superphosphate and prevent rotting of the bags. With the common salt treatment washing in pure water was necessary to remove a certain "stickiness" from the bags.

Treatments Recommended.

Although, as can be seen from the table above, most of the chemicals were effective in one strength or another in destroying the germinating power of the seeds, owing to practical difficulties of application some of the treatments have to be discarded.

Only the following are recommended:—

1. Dip the wheat bags, preferably turned inside-out, into vigorously boiling water until thoroughly wet; then spread out to dry; or

2. Immerse the bags, turned inside-out, in a 5 per cent. solution of copper sulphate or "bluestone" (5 lbs. bluestone dissolved in 10 gallons of water), for from 10 to 20 minutes and spread out to dry. More dilute solutions of bluestone eventually kill the seeds, but with the weaker strength germination commences and under "seed-bed" conditions in the soil some of these plants might survive. A 5 per cent. solution completely inhibits germination. Stronger solutions make the bags rather stiff and rather blue in colour. The bluestone solution should be used in a wooden barrel, washing copper, or some other container which will not be corroded by this chemical.

General Control Measures for Wild Turnip on the Farm.

Particulars of general field control of this bad weed will be found in previous articles in this Journal as follows:—

Journal of Agriculture of Western Australia, Vol. X., September, 1933, pages 409-419, The Wild Turnip (*Brassica Tournefortii*, Gouan), by C. A. Gardner, with notes on Cultural Methods of Control by G. L. Throssell, and

Journal of Agriculture of Western Australia, Vol. XI., June, 1934, pages 346-348, Wild Turnip (*Brassica Tournefortii*), Methods of Control by N. Davenport.

(It is realised that further experiments are necessary before the most satisfactory method can be discovered for the chemical destruction of *Brassica Tournefortii* seeds, but as the writer was until recently attached to the W.A. Dept. of Agriculture, and carried out the experiments recorded above while an officer of this Department, it is considered desirable that his pioneer work in this connection should be published at this stage. Further work can be continued from this point.—Editor.)

STRAIN CERTIFICATION OF AGRICULTURAL SEEDS.

Subterranean Clover (*Trifolium subterraneum*, Linn.).

G. R. W. MEADLY, B.Sc., Agricultural Adviser.

Considerable advancements have been made during the last decade in various phases of agriculture, and not the least of these is due to the recognition of strains within the species of fodder plants. Variations in plants may occur naturally or be artificially induced, by cross pollination or inbreeding. These variations from the original type may be morphological such as change in leaf size and shape; or affect the growth periods of different sections of the plant.

The features of a plant which make it of value from a fodder view point include permanence, time of maturity, palatability, growth form, period of growth and seed production.

CERTIFIED SEEDS.

The aim of the plant breeder is to incorporate in one strain the most suitable factors for the conditions under which the plant is to be grown. Once this strain has been evolved either by the breeder or by natural selection, its perpetuation is an important item to be considered. A system which has been formulated to carry out this work is known as seed certification. New Zealand, which is one of the leading seed producing countries of the world, introduced seed certification in the 1929-30 season. One of the most variable species sold commercially is Perennial Rye grass, and the New Zealand Department of Agriculture commenced its activities in this direction by certifying true to type a permanent and leafy strain under the name of Hawke's Bay Perennial Rye grass. Since then New Zealand White Clover, New Zealand grown Montgomery Red Clover, and Akaroa Cocksfoot have been added to the list of certified strains. So successful has this system proved that it has been adopted in the main for Rye grasses and Toowoomba Canary grass in Australia.

In New Zealand any farmer desiring to produce certified seed makes application to the Department of Agriculture. He is allotted a register number and the paddocks, which are the working units, receive letters for identification. These figures and letters are noted on tags attached to all bags of seed produced, and hence it is possible to trace back to the paddock of origin any line of certified seed.

Field inspections are made during the growing period, and when the grower is prepared to thresh seed it is his responsibility to give notice of his intention to the Department. The inspecting officer endeavours to be present during or immediately after threshing to count, seal and brand the sacks. The grower or some responsible person must sign a declaration guaranteeing that the sacks the inspector has sealed and branded contain no seed other than the produce of the registered areas.

When a merchant desires to machine dress seed contained in bags sealed in the field, an officer—

1. Notes the number of sacks and their weight;
2. Removes the seals and allows machine dressing to proceed;
3. Supplies the number of tags required;
4. Inspects the dressing returns;

5. Notes the number of sacks and weight of dressed seed;
6. Seals up the sacks of machine dressed seed;
7. Draws samples which are forwarded direct to the Department's seed analyst for purity and germination tests.

The result of this test is forwarded direct to the grower or merchant owning the seed.

PEDIGREE SEED.

A further step in seed certification is the production of certified *pedigree* seed. After the isolation of the so-called ecotypes such as Akaroa Cocksfoot and Hawke's Bay Perennial Rye grass more intensive selection is carried on.

Studies of single plants are made and the types showing maximum desirable features are selected and studied for a number of years during which time selfing and parental crossing is carried out.

The initial production of pedigree seed is a very slow process. Small quantities are now being produced in New Zealand, and the Aberystwyth Plant Breeding Station in Wales, after about **thirteen years** of investigation work, is now commencing to place pedigree seed on the market on a commercial scale.

STRAINS OF SUBTERRANEAN CLOVER.

Recognising the value to both producer and purchaser of a strain certification system the Department of Agriculture is initiating this season a scheme to certify true to strain the very early (Dwalganup) strain of Subterranean Clover (*Trifolium subterraneum*), and certain areas of Dwalganup Subterranean Clover have been passed as suitable for certification for this season.

Subterranean Clover is of European or South Asiatic origin, and was evidently introduced to Victoria as an impurity in agricultural seeds during the latter part of the nineteenth century and apparently reached this State about the same time.

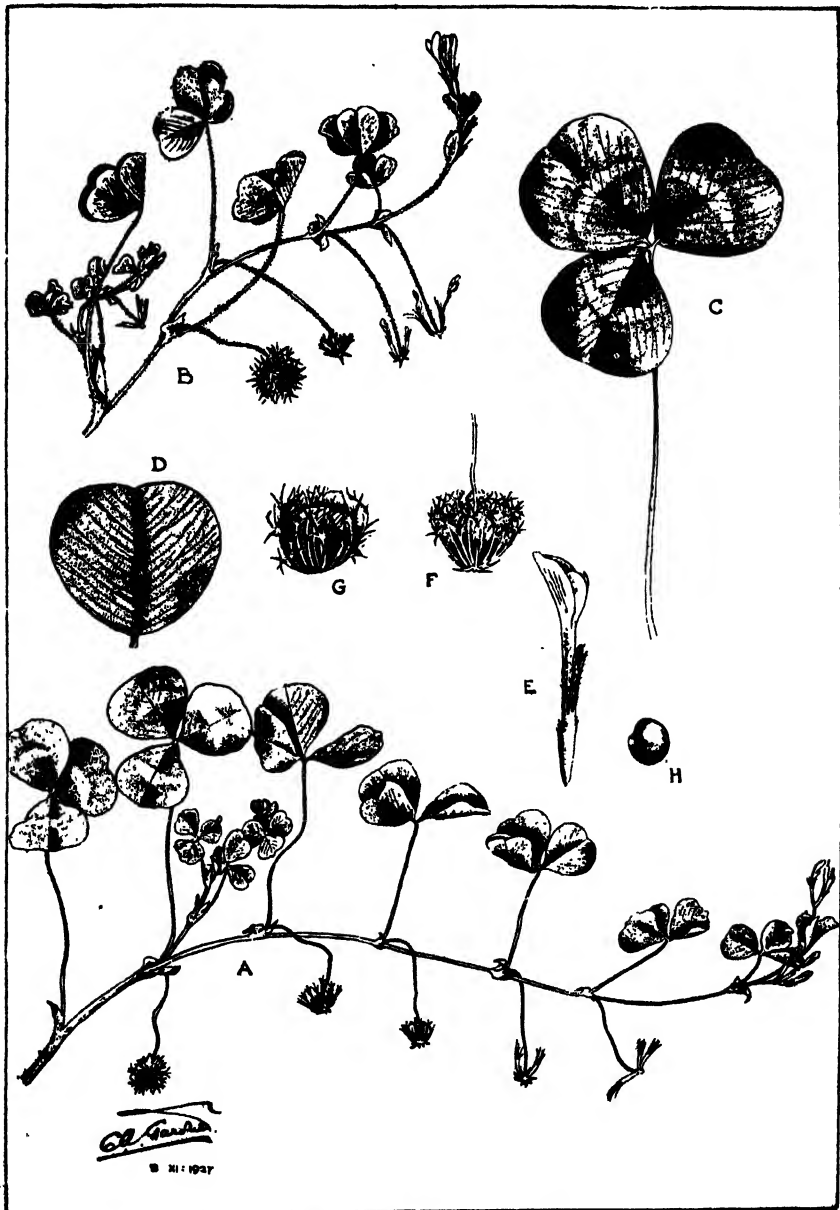
Various strains of this plant with different vegetative characters and growth periods have been noted from time to time until now in this State alone there are at least six recognised. Of these, Dwalganup (first early), Daliak (early), mid-season and Brunswick (late), are grown commercially for seed purposes. At present by far the two most important are mid-season and Dwalganup, and a few words concerning their characteristics will enable contrasts to be made.

The Dwalganup strain has fibrous trailing hairy stems with sparse leafage. White crescent-shaped markings and sometimes brown fleckings appear in the younger leaves, but these usually disappear later.

The calyx tube varies in colour from green to pink, the pink colouration being most pronounced (when present) at the apex of the tube. The plants normally commence to flower early in August, and by the end of September seed formation is well under way in the buried burrs.

Seed formation is heavier than in the case of mid-season, but apparently very few, if any, seeds will set in the burrs of the Dwalganup strain unless they are buried in the soil. This does not apply in the case of mid-season.

Dwalganup is a very hardy strain and the one most suitable for the areas of lighter rainfall, the limiting rainfall being in the vicinity of 17 inches.



SUBTERRANEAN CLOVER.
(*Trifolium subterraneum*, L.).

PLATE I.

Explanation of Plate.

- A. and B.—Portion of plant showing habit and development.
 C.—Leaf showing whitish crescent-shaped markings.
 D.—Leaflet with brown flecking (on veins near midrib).
 E.—Flower.
 F.—Maturing seed head.
 G.—Ripe burr with three pods.
 H.—Seed.

[After C. A. Gardner, Journal of Agriculture, Vol. X., March, 1933.]

The mid-season strain has shorter hairy stems and flower stalks and more abundant foliage. There is a decided, persistent, white crescent on the leaves, and brown markings may also be present. The calyx is bright red in the upper two-thirds, the remainder along with the teeth being green. Flowering usually commences in the latter part of September, with a correspondingly later seed setting. This strain is the one most commonly cultivated in the lower South-West and is suitable as far East as the 25-inch isohyet.

In the past some purchasers of so-called Dwalganup seed have found that the crop produced has consisted in part, or entirely of the mid-season strain. Although the former is not so leafy, it will grow and produce seed under considerably drier conditions, mainly owing to its earlier maturing habit. Besides often entailing the loss of a suitable crop, supplying seed of incorrect strain tends to convince a farmer that no strain of that particular plant will grow under his conditions.

CERTIFICATION OF SUBTERRANEAN CLOVER.

With the idea of protecting the farmer and at the same time assisting the grower and seed merchant, this certification scheme for Dwalganup Subterranean Clover has been evolved.

During October, at the request of various growers, areas of Subterranean Clover were inspected and those considered to contain a sufficiently high percentage of Dwalganup strain were passed for certification if so desired. Each producer was allotted a number and each paddock mapped was distinguished by a letter. It is intended to include the number and letter on the tag attached to each bag of certified seed. This tag will also bear the number of the test conducted on the seed for purity and germination. The results of this test may be secured by forwarding the reference number to the merchant from whom the seed was purchased.

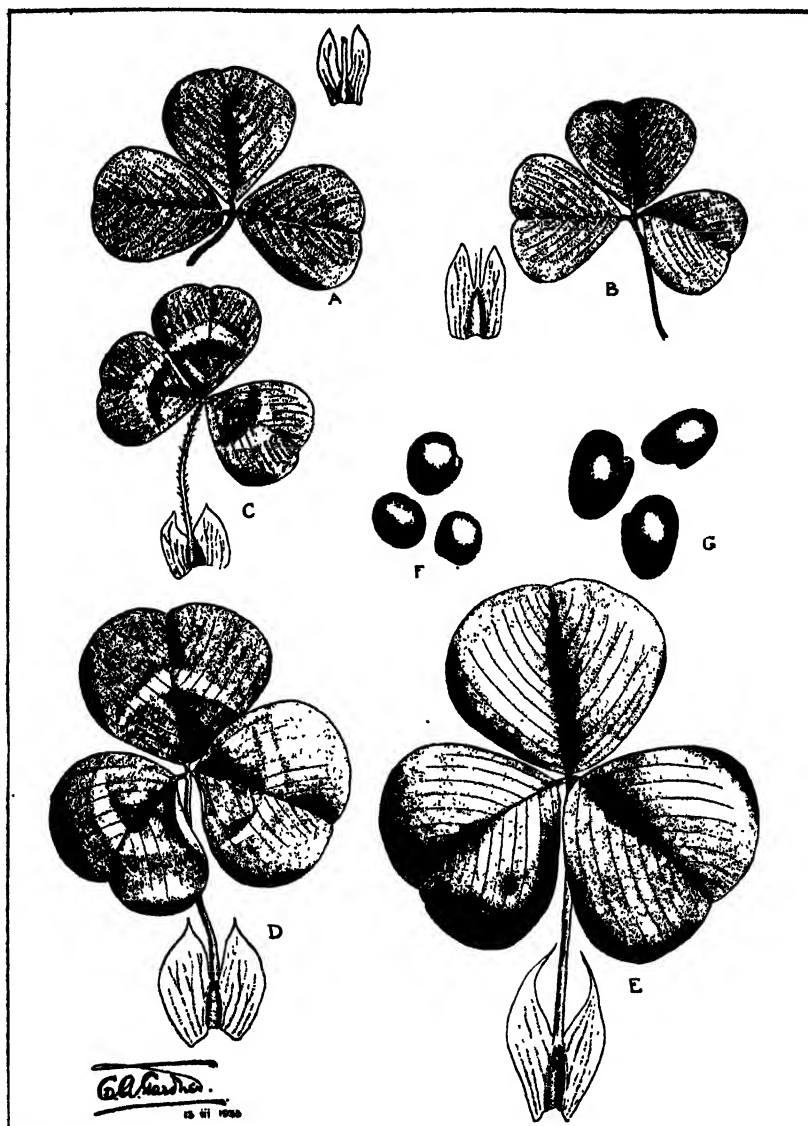
An officer of the Department will be present to note the areas from which the seed is gathered, seal the bags of certified seed, and attach the tag giving information concerning the seed. This seal remains intact until broken by the purchaser, thus ensuring the delivery of a reliable strain of seed.

FLUORESCENCE IN SUBTERRANEAN CLOVER SEEDLINGS.

H. C. Trumble, in the *Journal for Scientific and Industrial Research*, August, 1933, makes the following statement: "During the course of the work various pasture species have been subjected, whilst germinating on filter paper, to the ultra-violet light test. It has been found that whereas South Australian Commercial Subterranean Clover seed is non-fluorescent, an early flowering type from Dwalganup (W.A.) which is becoming increasingly important in the lower rainfall areas, is fluorescent. The fluorescence is, however, faint and unlike Rye Grass, the causal substance is confined to the root tissue and not exuded."

Because of the extreme importance locally of being able to distinguish between Dwalganup (extra early) and mid-season Subterranean Clover seed, especially in view of the certification scheme, a number of tests were conducted.

Several different lines of Dwalganup, mid-season and Wenigup strains of Subterranean Clover seed were germinated on moist white Whatman filter paper, and each allowed to continue growth for the same length of time (4 days and 6 days in the two series conducted). When these seedlings were viewed under screened ultra-violet light (4,000-5,000 angstrom units) from a mercury vapour



SUBTERRANEAN CLOVER.

PLATE II.

Leaves.

- A.—First Early Strain.
- B.—Dallak Strain.
- C.—Northam Early Strain.
- D.—Midseason Strain.
- E.—Brunswick Late Variety.

Seed.

- F.—Midseason Strain.
- G.—Brunswick Late Variety.

[After C. A. Gardner, Journal of Agriculture, Vol. X., March, 1933.]

lamp, a marked difference in the fluorescence of the three strains tested was noted. The fluorescing substance was apparently retained within the root except for small amounts at the junction of the filter paper and the root apices.

Maximum fluorescence was obtained with the Dwalganup strain which produced a bright blue root colouration. The Wenigup gave a pale greenish-blue, and the mid-season was intermediate between the two.

By using controls of Dwalganup and mid-season, ultra-violet light will probably be of extreme importance in detecting the presence of mid-season strain contamination in Dwalganup seed. Further investigational work along these lines should prove of value.

The apparatus used in these tests was kindly loaned by Mr. J. E. Blewett, local manager of H. Watson and Sons, Limited.

A NEW METHOD FOR THE PROPAGATION AND DISTRIBUTION, ON A SOLID MEDIUM, OF THE CHEESE STARTER ORGANISM, *STREPTOCOCCUS CREMORIS*.

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INTRODUCTORY.

A study of the "Statistical Register" of Western Australia for 1932-33 and previous years, which is compiled from official returns by the Government Statistician, Mr. S. Bennett, F.I.A., shows that there is an enormous scope for expansion of the local Cheddar cheese-making industry.

Thus the annual production of cheese for the whole of Western Australia, as therein set forth, for the years 1923-32, both inclusive, was as follows:—

Year.	Cheese made (lbs.).		
1923	4,365
1924	4,055
1925	3,818
1926	164,472
1927	149,269
1928	11,847
1929	998
1930	623
1931	909
1932	138,051

By contrast with this lilliputian production, the figures for the value of cheese imported into Western Australia during the same period are comparatively enormous. These are as follows:—

Year.	Value of Cheese Imported in £'s.		
1923-24	87,191
1924-25	70,533
1925-26	86,144
1926-27	87,602
1927-28	87,268
1928-29	106,626
1929-30	114,245
1930-31	87,739
1931-32	96,859
1932-33	84,364

The total amount of cheese produced locally in the last statistical period (1933-34) was 285,461 lbs. and the value of cheese imported into the State in the same period was £83,601, representing a value of £83,361 for imports from the Eastern Australian States, and £240 for imports from overseas (the respective weights of imports being 1,982,451 and 4,082 lbs.).

USE OF CHEESE STARTERS IN W.A.

Following on the establishment of the Serpentine Falls Cheese Factory at Serpentine, Western Australia, in August 1932, this Department was asked to undertake the work of propagating and distributing pure cultures of the lactic acid organism, *Streptococcus cremoris*, to the factory at frequent intervals, for use as cheese starters.

For several months the factory had been using cultures of this organism which were obtained, as required, from the Department of Agriculture, New South Wales; but it had been found that owing to the length of time taken for the cultures to arrive from Sydney, on the other side of the continent two thousand miles away, they were frequently rather reduced in vitality on arrival, and moreover, a very awkward and perturbing period of a week or so frequently elapsed between the time of contamination of the factory starter and the arrival of a new, uncontaminated one from the East.

The Superintendent of Dairying, Mr. G. K. Baron-Hay, therefore inquired of the writer whether it would be possible for the latter to prepare and distribute such cultures to the factory at regular intervals, as the Plant Pathology Branch had for many years been preparing and distributing to farmers pure cultures of the nitrogen-fixing organism *Rhizobium radicicola*, for the inoculation of leguminous seeds before planting. He was informed that if a pure culture were obtained as a starting point, and the formula for preparing the most suitable artificial media indicated, every assistance would be given. For a number of years the writer had been out of touch with developments in the dairy starter line, and assumed that during that time scientific knowledge on the subject would probably have increased to include a method whereby the organism would be culturable on solid media and would require only infrequent transfers from the old to new media to retain its vitality.

On the arrival of the first pure culture from Dr. R. J. Noble, Biologist, New South Wales Department of Agriculture, it was found that the task so lightly undertaken was to prove much more troublesome and time-consuming than had been anticipated, as the instructions received with the culture were to the effect that the organism had to be subcultured into a new lot of sterile milk every day, but, fortunately, could be kept alive over public holidays of a day or so, or over week-ends, in sterile milk to which a considerable amount of calcium carbonate (chalk) had been added before sterilising.

THE SEARCH FOR A SIMPLIFIED TECHNIQUE.

As the miscellaneous routine and research activities of the Plant Pathology Branch already consumed all the available time each day, without extra activities being undertaken, the writer immediately set about to try and invent some artificial medium of a solid kind on which the organism could be propagated and on which it would retain its vitality unimpaired for several weeks at least. The agar used for distributing the organism from the New South Wales Department of Agriculture is standard nutrient agar, on which the growth of the organism is so meagre that it is only with difficulty that it can be distinguished. A type of colony growth which would be more readily discernible to the naked eye was therefore desired.

With these varied ends in view, then, a considerable number of different types of solid media were made up, as, for example, "meat lactose agar," "meat lactose agar plus calcium carbonate," "milk agar," "milk agar plus calcium carbonate," "powdered skim milk agar," "powdered skim milk agar plus calcium carbonate," "powdered skim milk peptone agar" and "powdered skim milk peptone agar plus calcium carbonate." The *modus operandi* was to inoculate the various kinds of agar slopes with a nicrome wire loopful of organisms from sterilised milk which had itself been inoculated with the pure culture, and which was on the point of turning, or had just turned, thick. The growth, if any, was then observed for some days, and at the end of varying periods of time, the organism was subcultured from the solid medium into sterilised milk, and its vitality (if any) observed by the speed with which curdling took place.

THE NEW TECHNIQUE DESCRIBED.

For one reason or another all the above types of media were ultimately abandoned as unsatisfactory, and all subsequent work has been carried out on an agar medium which has proved very satisfactory for propagating the organism, and for retaining its vitality unimpaired for approximately thirty days.

After this period the vitality falls off fairly rapidly, but the organism has frequently been obtained in perfectly vigorous condition from an agar slope at the end of thirty-one or thirty-two days. Such a procedure is not recommended, however, as it has been found better and safer, in routine work, to subculture from the solid medium into sterilised milk or "milk carbonate" (i.e., milk containing calcium carbonate) when the culture is not more than ten days or a fortnight old, although if absolutely necessary, the organism may frequently be obtained in viable but not very vigorous condition from agar cultures forty days old. After subculturing from the solid medium to sterilised milk, the organism is resubcultured into two further changes of sterilised milk at daily intervals, before being transferred onto a new agar slope from the third batch of sterilised milk. Here again the organism can be left for ten days or a fortnight without any fear of its vitality diminishing, at the end of which period the subculturing into sterile milk for three repetitions, or into sterilised milk carbonate takes place. If subcultured into sterilised milk carbonate, experience indicates that resubculturings into sterilised milk carbonate are unnecessary except at weekly intervals. It appears that by weekly subculturings into milk carbonate the vitality of *Streptococcus cremoris* may be retained unimpaired indefinitely.

VALUE OF THE NEW AGAR MEDIUM.

This being so, the great value of the new agar medium is that the freedom of the culture from contamination can be determined by eye, from time to time, by subculturing from milk or milk carbonate to the solid agar medium; and the cultures which are to be distributed to cheese factories can be grown for a week, two weeks, three weeks, or longer, if necessary, on the artificial solid medium before being sent out from the laboratory. This allows of contamination with spore-forming organisms or other harmful types (if any) showing up before the cultures are forwarded, and the absence of a liquid medium obviates the possibility of leakages from the starter bottle, and subsequent possibility of contamination, before the culture arrives at its destination.

Several cheese starters recently arrived from the U.S.A. in the traditional milk plus calcium carbonate medium. The gas pressure which had developed during the voyage resulted in leakage past the "screw-on" stoppers into the surrounding sawdust packing. The result was a very copious growth of miscellaneous moulds on the stoppers and necks of the bottles, which was not conducive to pleasant work, or work free from the likelihood of contamination during subculturing

in the laboratory at the receiving end. Such a state of affairs would be obviated with a satisfactory solid medium for propagation and distribution of the cultures.

PREPARATION OF THE NEW AGAR MEDIUM.

The solid medium which was worked out by the writer in this laboratory, and which has been in use for the past two years, is known as "Peptone-lactose-phosphate-carbonate agar, usually designated "Peptone carbonate agar," or "P" agar for sake of brevity.

The formula for its preparation is as follows:—

1. Peptone	10.0 gms.
2. Lactose	50.0 gms.
3. Calcium carbonate (precipitated)	100.0 gms.
4. Tricalcium phosphate (P.B.)	12.5 gms.
5. Water (tap)	1000.0 ccs.
6. Powdered agar agar	25.0 gms.

(Peptone ten gms., lactose fifty gms., calcium carbonate one hundred gms., tricalcium phosphate twelve decimal five gms., water one thousand ccs., agar twenty-five gms.)

Autoclave the agar in the water till dissolved (say 30 minutes). Filter through cotton wool; squeeze out cotton wool by hand so as to obtain as much of the agar as possible. Add chemicals No. 1 to 4, both inclusive. Keeping the agar well rotated in the flask while pouring, to thoroughly incorporate the insoluble chemicals, pour into 2 oz. medicine flats or other suitable containers, insert the cotton wool plugs, sterilise in autoclave for 15-20 minutes at 15 lbs. pressure and slope. Just before sloping each bottle it should be well rotated in the hands so as to ensure good distribution of the insoluble materials, and should then be placed in a sloping position, without delay, for the agar to set. Frequently a little of the insoluble matter will become attached to the sides of the bottle, so that the clarity of the view through the glass may be somewhat impaired in spots. With care in the preparation of the medium, and the use of well-cleaned bottles, there should be very little adherence of calcium salts to the sides of the bottle.

Sometimes, for reasons not known, the bottles will be found, after the agar has solidified, to have a little free water at the bottom of each slope. As our invariable practice is to make up the slopes some weeks in advance of the time when they will be required for subculturing purposes (so as to avoid the possibility of using imperfectly sterilised slopes, etc.), this is not a disadvantage, as the excess water becomes absorbed before they are used.

DEVELOPMENT OF THE COLONIES.

On this medium, after inoculation with a nicrome wire loop of approximately 2.5 mms. diameter from the sterile "milk carbonate," or sterile milk, the organism becomes obvious to the naked eye as tiny, raised, colourless, glistening, pin-point colonies along the track traced out by the wire during the smearing of the loopful of liquid medium over the surface of the agar. At a room temperature of about 70 deg. F. the organisms first become obvious as individual colonies on about the third day after subculturing. Thereafter the individual colonies grow rather rapidly, rarely however exceeding about 0.5 mm. in diameter, even in very old cultures. In spite of the colourless, or almost colourless, nature of the colonies, they are very readily distinguishable by the naked eye, especially if the bottle is rocked slightly in the hand with a strong light shining on to the surface of the culture from one side. Where a number of colonies are growing in close proximity they may fuse to form a rather slimy continuous mass, but there is never sufficient

growth formed to "flow" down over the slope as occurs in the case of many bacterial cultures. As the colonies develop, the lactic acid formed passes down into the substratum and dissolves away the calcium carbonate, forming large clear pockets in the carbonate layer. Subculturing from a solid medium to a solid medium does not seem to be very satisfactory.

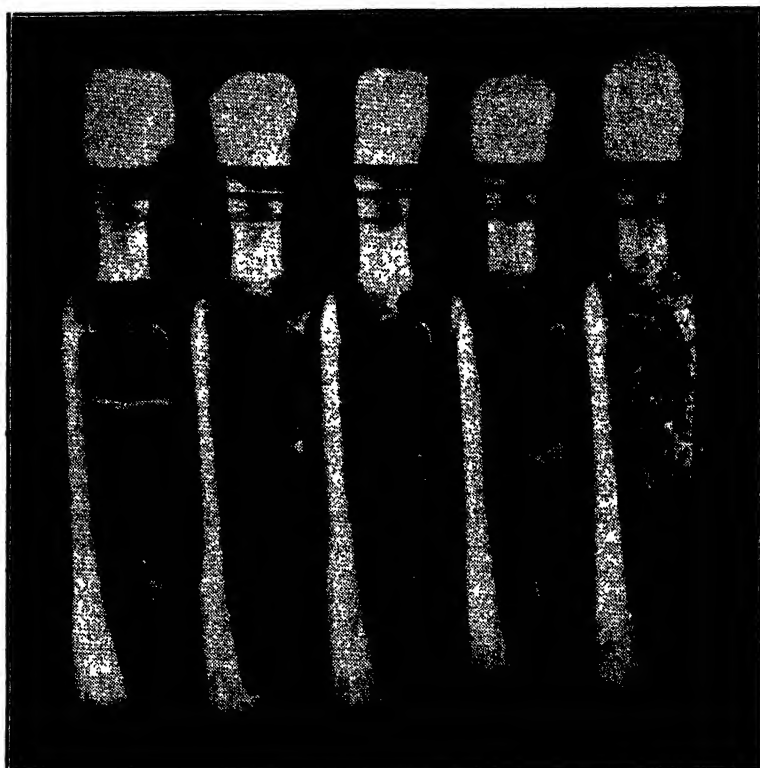


Fig. 1.—Five 2-oz. medicine "flats" containing "Peptone-lactose-phosphate-carbonate agar" slopes, made up as indicated in the text, and photographed from the side to show the heavy (white) layer of calcium carbonate below the surface of the agar. Some of the carbonate has adhered to the sides of the bottles during preparation of the slopes: but the amount and opacity of this has been exaggerated in the photographic process.

[Photo. by Govt. Printer.]

PREPARATION AND USE OF "MILK CARBONATE."

In preparing "milk carbonate," approximately ten grammes of precipitated calcium carbonate is placed into a 2-oz. medicine "flat" and approximately 25ccs. of whole milk is then run into the bottle. The carbonate need not be weighed out but may be estimated by eye. Ten grammes represent a height of about one inch in a two ounce medicine "flat." The milk similarly need not be measured out, but may be run into the bottles until the carbonate is quite wet and about five-eighths of an inch of milk, or slightly more, extends above the surface of the carbonate.

To ensure a considerable amount of mixing of the milk and carbonate, a day or so after subculturing has occurred, and when the milk has become more or less thick, the bottles are repeatedly lightly tapped on a wooden bench, while being held tilted at an angle of about 45 degrees, so that one corner of the bottle only

strikes the bench. This disturbs some of the carbonate and subsequent twisting of the bottles back and forth about their vertical axis ensures neutralisation of the lactic acid and the evolution of considerable gas. The curd also becomes more or less emulsified again as a result of this agitation.

With care, the splashing of milk on to the plug of the bottle can be avoided. When subculturing into or from "milk carbonate," the opportunity is taken to stir up the carbonate with the nicrome wire as much as possible. Some experiments are now being carried out to see if the addition of short lengths of glass rod to the bottles, before they are sterilised, will facilitate the mixing of the carbonate with the milk, without opening the bottles. Results to date indicate that the addition to each bottle of several pieces of glass rod, approximately three-eighths of an inch long and one-quarter inch diameter, greatly assists the disturbance of the carbonate, which otherwise tends to form a hard compact mass in the bottom of the bottle.

STERILISING OF MILK AND "MILK CARBONATE."

In connection with the sterilising of the milk, with or without carbonate, experience indicates that it may be necessary to use the discontinuous process in the steam steriliser for half an hour on each of six successive days, with a further sterilising on one or more days in the following week, before sterility can be safely assumed. The safest way is to give six to nine such sterilisings and then leave the bottles standing on shelves in a cupboard for a fortnight or more before being used. In the event of living spore-formers still being present after apparent sterilisation, it may be ten days or so before clearing of the curd or other changes in the milk develops to indicate non-sterility. During the protracted sterilising indicated above, it often happens that the milk becomes slightly brownish in appearance. So long as this is not very marked the vitality of the *Streptococcus cremoris* does not appear to be affected. In most of the work carried out in the writer's laboratory whole milk has been used, as it is difficult to obtain fresh skimmed milk locally. Until the necessity for great caution in presuming sterility had been learned, by bitter experience, a great deal of trouble with cultures becoming contaminated with spore-formers originally present in the milk was experienced.

SUMMARY OF SALIENT POINTS CONCERNING ROUTINE PREPARATION OF STARTERS.

During the two years that the writer has been distributing cheese starters to local factories (there are now three of them in operation) a total of approximately 1,200 subcultures have been made for various purposes, most of them being made by the writer. One culture is forwarded to each of the three factories each week, the cultures being usually about ten days or a fortnight old when sent out. It is considered that by weekly subculturing into sterilised milk carbonate to keep the line of "mother" starters going, by subculturing from milk carbonate to peptone-lactose-phosphate-carbonate agar for distribution (and "inspection") purposes, and by subculturing from cultures on this agar which are not more than two weeks old back into milk (three transfers), or into milk carbonate, the vitality of *Streptococcus cremoris* as a very vigorous cheese starter can be maintained for very long periods. My experiments show that the organism readily dies out in milk after the second day at a room temperature of about 75 degrees F. (although it may occasionally be recovered in a weakened condition from milk after four days); that it will live in milk carbonate for approximately a month at this temperature, without loss of vitality, if the precaution is taken in some way to keep the carbonate and milk intimately mixed every few days, especially at the beginning of the period; that it will live for approximately a month on the special agar already de-

scribed without loss of vitality; but that it is the best and safest practice to subculture it from milk at the end of twenty-four hours, from milk carbonate at the end of a week (as a maximum period), and from the special new agar at the end of a fortnight (again as a maximum).

When subculturing into, or from, the medicine "flats," the necks of the bottles must always be very well flamed (while the bottles are being twisted in the hands to prevent cracking of the glass), as there is frequently a bevelled inner edge to the neck of these bottles in which dust particles may settle from the air, after the medium has been prepared, and while it is being stored on a shelf before use.

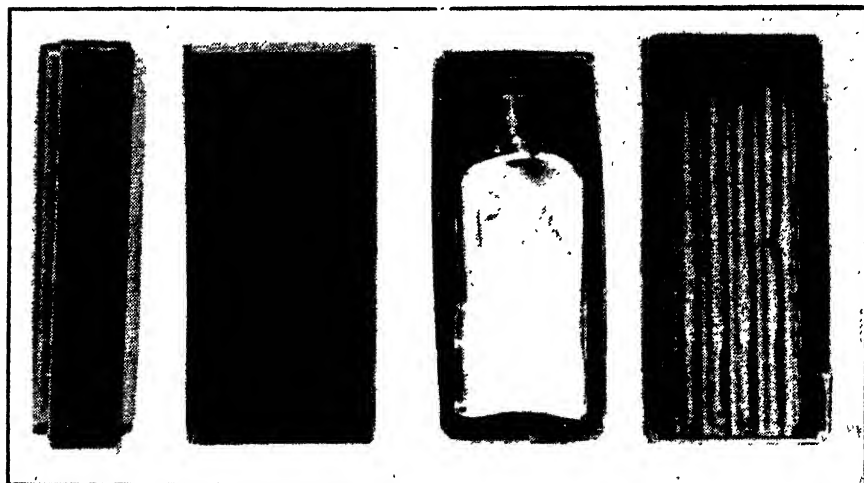


Fig. 2.—From left to right—(a), "Leatherboard" box for distributing cheese starters and other bacterial cultures, viewed from the side; (b), Same as (a), but viewed from above lid of box; (c), Bottom of box with oblong piece of corrugated cardboard below bottle, and 2-oz. medicine "flat" containing "Peptone-lactose-phosphate-carbonate" agar and culture of *Streptococcus cremoris*. The cotton wool plug has been blackened by flaming during the subculturing process and does not show very clearly in the photograph. Before despatch, the necks of the bottles and plugs are very well flamed by rotating in the flame of a bunsen burner, the plug then being pushed well down into the bottle, until the bottle and plug form a tight fit lengthwise in the box; (d), Lid of box with oblong piece of corrugated cardboard inside to take up the slack and offer protection to the top of the bottle.

[Photo. by Gort. Printer.]

Owing to the absence of a low temperature incubator, all the work which has been done with this organism locally has perforce been carried out at room temperature. This varies in mid-summer from approximately 34 degrees C. (93.2 degrees F.) to approximately 12 degrees C. (53.6 degrees F.) in mid-winter. The cultures are kept in complete darkness, except when being actually worked with in the laboratory.

A NEW METHOD OF DISTRIBUTING BACTERIAL CULTURES BY POST.

The cultures on the new agar are distributed to the cheese factories in small, good quality "leatherboard" boxes, which are fastened with a gummed wrapper rolled round the box as indicated in Fig. 3. The wrapper is 2 feet 3 inches long and 4 $31/32$ inches wide, and is completely covered with best quality adhesive gum on the back. It is long enough to completely wrap around the box four times plus an overlap of about $1\frac{1}{2}$ inches. The wrapper is placed gum side uppermost on the laboratory table, with the "top" end caught in a wide-mouthed spring paper clip, temporarily fastened to the table. A little water is wiped over the gummed surface and the box is then rolled up in the wrapper, starting from the "bottom"

or free end of the wrapper (which is devoid of printing). The spring clip keeps sufficient tension on the wrapper to prevent buckling of the paper as the box is being rolled up in it. This method is also used for distributing nitrogen-fixing bacterial cultures to farmers, for the inoculation of leguminous seeds before planting. It is very quick, and has resulted in a great saving of time over the old method of wrapping in corrugated cardboard, brown paper and string. To take up the slack inside the box an oblong piece of corrugated cardboard is placed above and another below the bottle, in the case of cheese starters, but not in the case of cultures of nitrogen-fixing bacteria, as in this latter case the slack is taken up by a small packet of tricalcium phosphate and the printed directions sent out with each culture.

DETAILED DESCRIPTION OF PRINTING ON GUMMED WRAPPER.

On one end (the "top" end) of the non-gummed side of the wrapper is printed: "O.H.M.S., Bacterial culture for Only, from Department of Agriculture, Perth, W.A.," and the words "GLASS WITH CARE" are printed in red printer's ink four times down the left hand side of the wrapper and the same number of times down the right hand side. The repetitions are so spaced that no matter how the wrapper is applied, each side of the box will show this warning caption at least once. Only five of these eight "Glass with Care" signs are required on boxes containing 2-oz. "flats," but as the same wrapper is also used for 8-oz. bottles (of nitrogen-fixing bacteria) the three extra repetitions are then revealed, owing to the larger periphery of the bigger box. On the left hand side of the wrapper

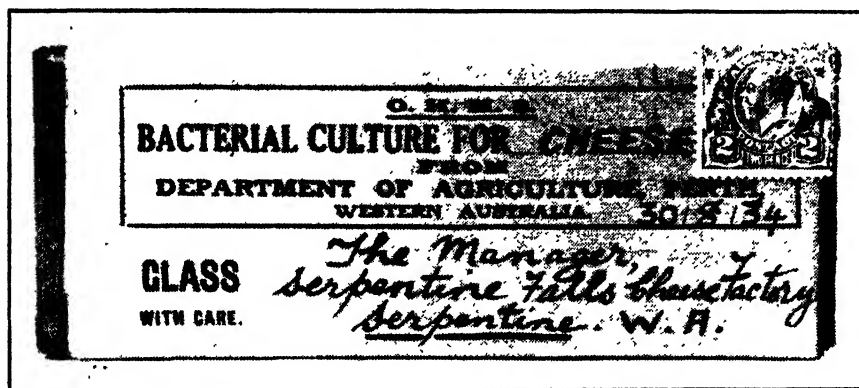


Fig. 3.—"Leatherboard" box, as pictured in Fig. 2, containing culture of *Streptococcus cremoris* in 2-oz. medicine "flat" on "Peptone-lactose-phosphate-carbonate agar," wrapped in special gummed wrapper described in text and ready for despatch through the post. From the point of view of complying with the postal regulations it is advisable to add the word "ONLY" after or below the word denoting the type of culture being forwarded, and this should not be obscured or obliterated by the postage stamp, etc.

[Photo. by Govt. Printer.]

the warning caption commences $7/32$ nds of an inch from the black border line below "Western Australia," but on the right it starts $1\ 11/32$ nd inches below this line. (See Fig. 3.) This gives a "staggered" effect to the warning words, and ensures that on each of the two narrow sides of the box the red ink notice appears once, but on the bottom of the box it appears twice (i.e., on one pair of left and right diagonally-opposite corners). The vertical distance between the bottom of one "Glass with care" notice and the top of the one beneath it is $1\ 21/32$ nd inches. The area within the black border to the printing at the top of the wrapper is $15/16$ th of an inch wide, and the border is placed $3/16$ th of an inch below the top edge of the paper. The 2-oz. boxes, with the lids on, and empty, measure $5\frac{1}{2}$ inches long, $2\frac{1}{2}$ inches wide, and $1\frac{1}{2}$ inches high.

SAFETY OF THE CULTURES IN THE POST.

Although many hundreds of cultures of various sorts have been sent out in this way through the post, no breakages of 2-oz. bottles have been reported, and since a piece of corrugated cardboard has been used above and below each 8-oz. bottle as a routine procedure and "Glass with Care" notices have been printed on the wrappers in the manner indicated above, no breakages of 8-oz. bottles have occurred. When the gummed wrappers were first introduced they were devoid of such notices and several breakages of the large-sized bottles occurred, possibly owing to the too zealous cancellation of the postage stamps by the post office officials.

KEEPING OF RECORDS.

In propagating the cheese starters it is of great assistance if a record of the various subculturings is kept by the use of foolscap sized paper forms, on which rows of empty oblongs, each about one and three-quarter ($1\frac{3}{4}$) inches long and three-quarters ($\frac{3}{4}$) of an inch wide, are printed. Each of these oblongs represents one (2-oz.) bottle. There is a space of about one-half inch between each diagrammatic representation of a bottle and its neighbour, and about one and a half inches clear space between each horizontal row of bottles.

The type of medium being used, and the number of the culture being worked with, is entered in one of these spaces for each separate bottle. When various subcultures are made from the same bottle thus represented on the chart, lines are drawn to the various bottles in the row(s) below which represent the individual subcultures. These are each numbered and the type of medium written into the appropriate oblong. The date can also be written into the space representing the bottle, or, if a number of subcultures are made on the same day, the whole group of bottles used can be ruled off and the date put in the margin.

By some such scheme as this it is easy to see at a glance what cultures are on hand, their varying ages, and the necessity for further subculturings being carried out by a certain date. The history of each culture is also able to be traced out without any trouble.

As the various cultures are forwarded to the cheese factories, they are crossed off the record sheets, and a further separate record of the number and "date of birth" of each culture which has been forwarded, with date of its despatch, is kept on a card index.

FURTHER WORK REQUIRED.

As indicated above, the work outlined in this article was undertaken under the spur of necessity, as the miscellaneous daily activities of the Plant Pathology Branch were already so heavy that the additional daily subculturing of cheese starters, which is required by the conventional method of propagating them, could not be contemplated with anything like equanimity. Lacking a special officer to attend to this work, it appeared that the propagation of these cultures would become a burdensome tie to Head Office and would prevent any lengthy visits to the country. The invention of the new agar has very much lightened the work and allowed of fairly long absences from Head Office, as cultures can be prepared before departure, with instructions that they be despatched on a certain date in the absence of the officer responsible for their propagation.

No systematic research work on the problem has been possible owing to pressure of other matters, and it is possible that great improvements and labour-saving devices can still be introduced into this field. The results given above are now published in the hope that they may stimulate other workers with more time at their disposal, and more extensive equipment than that available to the author, to investigate what appears to be a much neglected aspect of the propagation of cheese and butter starters.

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.	
	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.		
	Maximum.	Highest.	Minimum.	Lowest.	For Month.	Age.
SEPTEMBER, 1934.						
Chapman State Farm	70.1	79.8	46.1	39.6	1.64	1.64
Geraldton	70.0	76.0	52.5	43.0	0.50	1.35
Walbling	64.1	73.2	41.1	35.1	1.46	2.15
Perth	66.4	77.8	51.4	43.3	3.32	3.41
Kalamunda	63.6	74.0	49.0	41.2	4.60	4.67
Bunbury	65.1	78.4	49.3	38.8	3.53	3.64
Bridge town	64.9	79.0	43.1	33.0	4.53	3.97
Albany	64.4	76.0	48.8	42.3	5.57	4.17
Marredin State Farm	69.4	84.0	42.8	32.5	0.61	0.88
Northam	68.5	80.0	46.0	36.6	1.00	1.61
York	67.7	79.0	44.2	36.0	1.30	1.60
Naragin State Farm	64.1	75.4	43.5	34.2	1.58	2.30
Kalamining	63.1	75.0	44.5	33.7	1.86	1.96
Cape Leeuwin	63.2	68.0	53.0	48.0	4.00	3.48
OCTOBER, 1934.						
Chapman State Farm	77.5	93.4	48.7	41.9	0.24	1.00
Geraldton	72.0	83.5	51.6	42.8	0.25	0.74
Walbling	75.2	96.0	45.2	35.6	0.31	1.38
Perth	69.1	83.0	50.6	45.0	0.94	2.24
Kalamunda	68.2	81.0	48.5	41.2	1.41	3.20
Bunbury	68.2	72.2	48.1	37.8	0.86	2.43
Bridge town	68.6	82.0	41.6	33.2	2.04	3.00
Albany	65.2	75.0	48.8	43.0	0.32	0.53
Marredin State Farm	77.4	95.6	44.3	34.1	0.31	1.05
Northam	74.1	91.0	45.9	38.0	0.31	1.10
York	73.2	91.8	43.7	30.5	0.73	1.47
Naragin State Farm	69.4	80.5	41.9	31.0	0.73	1.57
Kalamining	67.8	85.0	43.2	33.0	0.77	1.57
Cape Leeuwin	63.1	68.8	53.8	48.0	2.00	2.94
NOVEMBER, 1934.						
Chapman State Farm	84.0	98.0	55.3	42.0	0.34	0.31
Geraldton	78.8	95.0	58.8	47.0	0.23	0.25
Walbling	79.5	100.1	50.4	42.2	0.75	0.52
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This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

Fruit Packing and the Marketing and Exporting of Fruit, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

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